DOCUMENT RESUME

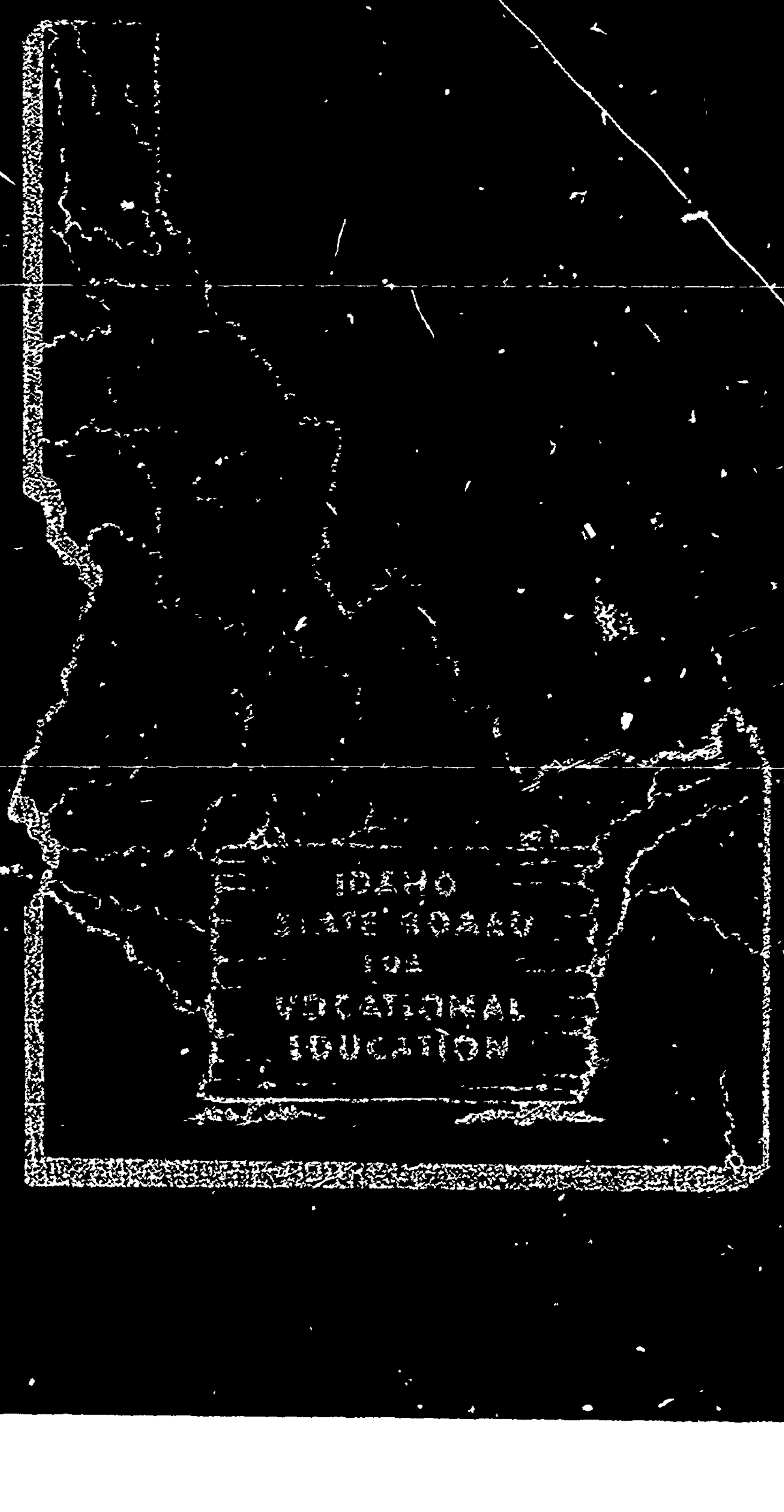
ED 027 377 VT 006 316

A Manual of Instruction for Log Scaling and the Measurement of Timber Products.
Idaho State Board for Vocational Education, Boise. Div. of Trade and Industrial Education.
Report No-Vo-Ed-No-38
Pub Date [60]
Note-123p.
EDRS Price MF-$0.50 HC-$6.25
Descriptors-*Forestry, *Forestry Occupations, Lumber Industry, *Manuals, Natural Resources, Textbooks, *Trade and Industrial Education, Trees, *Vocational Agriculture

This manual was developed by a state advisory committee in Idaho to improve and standardize log scaling and provide a reference in training men for the job of log scaling in timber measurement. The content includes: (1) an introduction containing the scope of the manual, a definition and history of scaling, the reasons for scaling, and the responsibilities and qualifications of the scaler, (2) safe practices in log scaling, (3) principles of log scaling containing units of measure, theory and use of the log rule, scaling equipment, log measurements, merchant ability, numbering and lettering of logs, over-run and under-run, records and reports, non-utilization scaling, and check scaling, (4) identification of tree species, (5) log defects and determination of deductions, (6) scaling from the stump, (7) measurement of post, mining timber, poles, pulp, and log decks, and (8) log grading. There are thirteen tables and 112 illustrations some in color, supplementing the printed text. (DM)

VO-ED No. 38

A MANUAL OF INSTRUCTION FOR LOG SCALING AND THE MEASUREMENT OF TIMBER PRODUCTS



A MANUAL OF INSTRUCTION FOR LOG SCALING AND THE MEASUREMENT OF TIMBER PRODUCTS

Prepared by
Division of Trade and Industrial Education
Idaho State Board for Vocational Education
and the
State Advisory Committee for Log Scaling

3

IDAHO STATE BOARD FOR VOCATIONAL EDUCATION

GEORGE E. DENMAN
State Director, Vocational Education

S. R. GLENN
State Supervisor, Trade and Industrial Education

IDAHO STATE BOARD FOR VOCATIONAL EDUCATION

FOREWORD

The forests of Idaho cover approximately one-third of her total area and represent a resource which is vital to her economy. The processing and marketing of forest products has grown into one of the foremost industries in the State, not only from a monetary standpoint, but also in numbers of workers employed. This growth has not been without problems, however, and timber measurement ranks high on the critical list.

Diversified ownerships, inadequately trained scalers, and other conditions pertinent to the harvesting and measurement of forest products in local areas of the State have resulted in a variety of procedures being used for timber measurement. These varied procedures were satisfactory for a time; but, as timber became more inaccessible and more expensive to harvest, a need for greater accuracy and uniformity in timber measurement was evident.

In the early 1920's, the lumber industry requested the assistance of the Idaho State Board for Vocational Education in correcting the timber measurement problem. In answer to this request, the vocational board employed Clyde E. Knouf, Lumberman, U.S. Forest Service, to help in solving this problem. As a partial solution, Mr. Knouf conducted a series of short, intensive courses for log scalers in the Coeur d'Alene and Priest Lake areas. In 1922, the Idaho State Board for Vocational Education first printed the material used by Mr. Knouf in his classes in a bulletin entitled "Trade Course in Log Scaling for Idaho Woods." The original bulletin was revised and reprinted in 1924.

The classes conducted by Mr. Knouf and the two editions of the manual did much to improve and to standardize log scaling, not only in Idaho, but in surrounding states as well. Both Mr. Knouf and the manual gained wide recognition in the field of log scaling.

In recent years, considerable emphasis has been placed upon greater utilization of forest products. This, together with increased harvesting costs and technological advances in the industry, has again brought about a need for more uniformity and accuracy in timber measurement.

During the winter of 1957-58, the Northern Idaho Forestry Association and the Southern Idaho Forestry Association requested that the Idaho State Board for Vocational Education assist in training men for the job of log scaling and timber measurement. In order to be assured that the training offered would not be based upon obsolete practices, the Idaho State Board for Vocational Education appointed representatives from the lumber industry and from the State Land Department to a State Advisory Committee for Log Scaling. The general responsibilities of the committee were to review the old manual and to recommend such changes as were necessary to bring it up to date. Consultants from the Western Pine Association, the U.S. Forest Service, the University of Idaho College of Forestry, the Bureau of Land Management, and the State Forestry Department were appointed by the vocational board to assist the committee in various technical phases of the manual.

The Trade and Industrial Division of the Idaho State Board for Vocational Education is greatly indebted to the following individuals, who gave freely of their time and knowledge in the rewriting of this manual and to their employers who made it possible for them to participate in committee activities:

Members of the State Advisory Committee for Log Scaling

Chairman
AL ROSHOLT
General Manager
R. G. Haley Corporation
Lewiston, Idaho

EDWARD F. LEMON
General Manager
Idaho Pine Company
Meridian, Idaho

FRANK AKRIDGE
Scaling Supervisor
Boise Cascade Lumber Company
Emmett, Idaho

THOR NYBERG
Head Check Scaler
Potlatch Forests, Incorporated
Lewiston, Idaho

ART C. HUBBARD
Check Scaler
Brown's Tie and Lumber Company
McCall, Idaho

JOE C. PARKER
Woods Production Manager
Diamond Gardner Corporation
Northwest Division
Spokane, Washington

ROGER TEMPLETON
Check Scaler
Idaho State Land Department
Boise, Idaho

Consultants to the Committee

R. L. GILBERTSON
Assistant Professor
College of Forestry, U. of I.
Moscow, Idaho

LYNN KNIGHT
Forester
Boise National Forest
Boise, Idaho

ROGER GUERNSEY
State Forester
State Forestry Department
Boise, Idaho

A. O. NOUSIANEN
Forester
U.S. Forest Service
Missoula, Montana

DENNIS HESS
Forester
U.S. Bureau of Land Management
Boise, Idaho

ROBERT H. SEALE
Associate Professor
College of Forestry, U. of I.
Moscow, Idaho

FREDERIC D. JOHNSON
Instructor
College of Forestry, U. of I.
Moscow, Idaho

LOUISE THUNEMANN
Materials Writer
Idaho State Bd. for Voc. Ed.
Boise, Idaho

ORLO B. JOHNSON
Check Scaler
Western Pine Association
Portland, Oregon

GERALD WILLIAMS
Forester
U.S. Bureau of Land Management
Boise, Idaho

VIOLA ELLIS
Committee Secretary
Idaho State Bd. for Voc. Ed.
Boise, Idaho

The material which follows is a second revision of the manual "Trade Course in Log Scaling for Idaho Woods." It should be a valuable help to those who are employed as log scalers, to those who are teaching log scaling classes, and to those who are learning the log scaling occupation. The new manual should also assist materially in standardizing a system of measurement for Idaho forest products.

S. R. GLENN
State Supervisor
Trade and Industrial Education

GEORGE E. DENMAN
State Director
Vocational Education

CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

I INTRODUCTION

SCOPE OF THE MANUAL

Timber products include a broad array of commodities which are derived from the trees themselves. If the harvesting and marketing of these products is to be carried out in a satisfactory manner, there must be some degree of standardization as to quantity and quality. To this end, generally accepted methods and units of measurement have been developed through the years. It is with these methods and these units that this manual is concerned, with major emphasis on the measurement of sawlogs. Some information on the measurement of poles, posts, mine stulls, pulpwood, and cordwood is also included.

There is an index at the back of the manual for convenience in locating material on specific subjects.

DEFINITION OF LOG SCALING

Basically, scaling is the measurement of logs to ascertain their usable contents in board feet. This measurement is neither a guess nor an estimate, but rather the result of applying certain fundamental rules and techniques.

Scaling may also include the measurement of timber products where units other than the board foot are basic. In its broadest sense, scaling may be defined as the process by which the net usable contents of timber products are expressed in acceptable units of measure.

HISTORY OF LOG SCALING

THE SCALER

No history of log scaling would be complete without some recognition of the scaler himself.

The early-day scaler was the "aristocrat"—the "professor" of the logging camp.[1] He was a man in whom the lumbermen placed special trust to protect their interests and upon whom the lumberjacks and others relied to arbitrate and to settle disputes. His character and honesty were above question. The scaler was first, last, and always a woodsman. He was recognized throughout the industry as a specialist, skilled through many years of experience and association with the logging industry. At the business of log scale and defect deduction, he was an expert who prided himself on the accuracy of his work.

Today, in spite of changes in logging practices, the position of the scaler remains the same. He is still the "specialist" and must be considered as such by the entire industry, for upon his shoulders rests the interests not only of the boss, but of the fallers, buckers, haulers, and others. His scale forms the basis of agreement between buyer and seller on volume of timber; and, in many instances, his scale is the basis of payment for the entire logging crew. In short, he must satisfy the whole industry. To do this, he must be a man of honesty, a man of substance, a man with special skill and ability, and a man with a deep pride in his work.

EARLY SCALING PRACTICE

The first known system of scaling was very crude. In order to determine the scale of an average-sized log, the scaler went to several skidways or

[1] R. W. Billings, Chief Forester, Diamond Gardner Corporation, Newport, Washington, in a speech given at the Intermountain Logging Conference, Spokane, Washington, March, 1958.

landings and scaled from 10 to 200 logs on each. He then made a count of the logs on each skidway or landing and multiplied the scale of the average log by the total number of logs in the landing. In this manner the scaler calculated the scale for each separate landing, as well as the total scale for all landings.

For a time, the average of the top and butt diameters was used to compute the scale, but manufacturers soon found that the volume of lumber actually realized was less than the scale; hence, it became almost universal practice to scale according to the average diameter of the top end of the log. The same practice is in use today.

NUMBERING LOGS

The numbering of logs has been practiced for many years. At first, the logs were numbered on the top or scaling end; but, because of the number of logs missed, either intentionally or unintentionally, the practice of numbering all logs in sequence on the "down river" end of the rollway, regardless of butt or top, was adopted. This latter practice made it possible to obtain an easy, accurate check on the total number of logs in the rollway and to reduce the possibility of an inaccurate report.

Today the numbering of logs is similar in that each log, whether it is merchantable or cull, is numbered in sequence at one end of the landing, deck, truck, gondola, etc., regardless of whether log ends are butt or top, with identifying mark at opposite end.

RECORDING THE SCALE

In the early days, instead of recording the scale of individual logs on tally sheets or in scale books, the scaler merely recorded the total scale for the day in a company passbook. He usually "kept tab," as recording was called, on a piece of hardwood, planed smooth and scraped with glass. When the piece of wood was covered with figures, or at the end of the day, the scaler would record the totals in the passbook and then scrape the tally board clean. This method gave no information on individual logs, and it was next to impossible for a check scaler to determine sources of error.

In order to remedy this situation, a method was devised in which the scale of individual logs was recorded on tally sheets and also on the ends of the logs scaled. This practice was followed for some time, but experience proved that the scaler did not always put the same figures on the sheets that he put on the ends of the logs.

Some companies adopted a system of numbering the logs on the top end and of recording on cards, opposite the corresponding log number, the length and scale of each individual log. The length and scale were then transferred from the cards into large tally books. Scale records that contributed to the permanency of the scale were improved; today the scaler records length, diameter, species, gross scale, deductions for defect, and net scale directly in his scale book, which becomes a permanent record.

DEDUCTION FOR DEFECT

Since its earliest days, the lumber industry has sought for accurate and efficient methods of making deductions for loss caused by various timber defects. The two most common methods used in early days were: Reducing either the diameter or the length of the log to compensate for defective material; or making flat percentage reductions from the gross scale. Procedures and methods were gradually improved until the present system of scaling each log on its own merits was adopted. In order to arrive at a gross scale under the present system, each log is first scaled as if it were perfect. The actual amount of defective material in board feet is then calculated and deducted from the gross scale. When correctly applied, this method gives very accurate results.

REASONS FOR LOG SCALING

The control of an entire timber operation revolves around the log scale. The log scale is a critical concern for the following reasons:

1. *It serves as a measure of timber products bought or sold.* Almost without exception, final settlement of timber sales is based on log scale.
2. *It serves as a measure of work accomplished* in each phase of the entire operation.
3. *It serves as a check on the accuracy of a cruise.* If a tract of timber has been appraised and sold on the basis of values and volumes derived from cruise information, the log scale is used to determine the accuracy of the cruise and the consequent profit or loss on the transaction after the timber is cut.
4. *It serves as a measure of inventory.* Log scale is the basis of log inventory and aids in planning operations and calculating risks.
5. *It serves as a means of identifying logs.* Accepted scaling practice includes the proper identification of each log, a number on one end and a letter on the other. These identifying marks assist in routing logs to their proper destinations and, in some instances, in determining ownership.

RESPONSIBILITIES OF THE SCALER

According to his employer's situation, requirements, and methods of operation, the responsibilities of the scaler will vary to some extent. Essentially the scaler's job is to provide his employer with the most accurate and unbiased scale he can obtain. Generally he is responsible for:

1. Observing scaling rules, merchantability specifications, and contract regulations under which the timber is to be scaled.
2. Identifying tree species in the area.
3. Identifying defects occurring in species in the area.
4. Classifying materials to be measured such as: Sawlog, peeler, pulp, pole, etc.
5. Numbering, recording, and reporting of logs.
6. Notifying his employer of poor bucking, felling, or other operations which may affect the quantity and/or quality of logs being harvested.
7. Scaling each log on its own merit regardless of stumpage value, mill overrun or underrun, previous log scale, or any other factors that might possibly influence his judgment.

QUALIFICATIONS OF THE SCALER

The success or failure of a sawmill or logging operation may depend upon the scaler. Because this is true, the scaler must be a well-qualified, well-trained, competent man worthy of the responsibilities that are his.

In general, the scaler should possess the following personal qualifications:

1. Good physical health.

2. Ability to work *rapidly*, *accurately*, and *safely*.
3. Good color vision.
4. Aptitude for arithmetic.
5. Ability to write legibly.
6. Honesty.
7. Ability to exercise independent judgment.
8. Systematic and analytical nature.
9. Willingness and ability to work with people.

II SAFE PRACTICES IN LOG SCALING

Log scaling has long been considered a hazardous occupation. In recent years, however, accident frequency and severity have been greatly reduced; and through an awareness of existing dangers and a careful observance of safe practices, it is possible to reduce the hazards further.

Management has helped to establish safety-conscious attitudes among workers by requiring supervisors to give new men necessary safety training, by providing adequate first aid administered by well-trained personnel, and by encouraging all men to participate in safety meetings. Basically each man is accountable for his own safety, and he should accept the responsibility of observing practices which will preserve his own safety.

Because of the variations in equipment and in locations where the actual scaling is done, no one set of safety rules will apply to all scaling operations. Below are listed some general rules for promoting safe practices and some specific rules for certain situations:

GENERAL RULES FOR SAFE PRACTICES IN SCALING

The log scaler should:

1. Be aware of job hazards before starting work.
2. Report to the proper person all unsafe equipment and/or unsafe practices he may observe.
3. *Wear a hard hat.*
4. Wear clothing suited to the job and the location.
5. Inform woods workers as to where he is working, but not depend on them for his safety.
6. Move to a safe place as soon as scaling is completed. Extensions in the scale book can be made at a safe distance.
7. Stay clear of logs until all equipment is out of the way and the logs have stopped rolling and sliding.
8. Stay clear of running lines, moving chokers, swinging logs and rigging, and jammers and cranes that are in operation.

SAFETY RULES FOR TRUCK SCALING

In truck scaling, the scaler should:

1. *Under no circumstances permit adjustment of binders or removal of binders while he is scaling the load.* More deaths have resulted from failure to observe this rule than from any other single cause.
2. Watch for slivers on butt logs while climbing on and off trucks or marking the ends of logs.
3. Stay clear of the loaded truck as it leaves the landing.
4. Watch for unguarded exhaust stacks on trucks.
5. Remember that calks on steel are treacherous.
6. Scale only while truck is not moving.
7. Not go under the jammer boom to scale a log.
8. Not walk between trucks and brow logs at unloading stations.
9. Not engage in horseplay on the job.

10. Not attempt to speed up loading by taking chances.
11. Not scale loads that are ready to dump.

SAFETY RULES FOR SAW SCALERS

The saw scaler should:

1. Let the saw gang or fallers know when he enters and leaves the sawing strip.
2. Always test the stability of a log before putting his full weight on it.
3. Never approach a felled tree for scaling from the downhill side.

SAFETY RULE FOR SCALING LOG DECKS

The scaler should not cross or work on decked logs or rollways below logs without first securely blocking the logs.

SAFETY RULES FOR SCALING ON WATER

The scaler who is working on water should:

1. Be able to swim.
2. Wear a suitable pre-inflated life jacket or belt.
3. Use footgear with sharp calks.
4. Scale only logs which are satisfactorily rafted, boomed, or controlled.
5. Arrange scaling periods in order to avoid scaling when there are high winds, currents, or tides; when logs are covered with ice or snow; or when logs are on rafts that are being towed.

III PRINCIPLES OF LOG SCALING

UNITS OF MEASURE

Diameter measurements of trees and logs are expressed in inches. Length measurements of trees and logs are expressed in feet.

Inasmuch as sawlogs are bought and sold by board foot measure, the unit of volume most commonly used in the lumber industry is the board foot. A board foot consists of a piece of lumber 1 inch thick, 12 inches wide, and 1 foot long. The number of board feet in any piece of *lumber* is obtained by multiplying the product of the width and thickness in inches by the length in feet and dividing by 12. It is necessary to divide by 12, because the width of the board is expressed in inches rather than feet.

Poles, posts, and ties are usually bought and sold by the piece according to specified diameters and lengths; mining timber by the piece, linear foot, or board foot; firewood by the cord; and pulpwood by the cubic foot converted into cords, although a large amount of pulpwood is sold by the board foot.

THEORY AND USE OF THE LOG RULE

As previously indicated, the contents of sawlogs are expressed in board feet. The volume of any given log is determined from a table called a log rule, which shows the calculated number of board feet that can be cut from perfect logs of various diameters and lengths.

Numerous rules have been used in Idaho; but, because of its long standing use and acceptance by both timber buyers and sellers, the Scribner decimal C log rule is considered the statute rule in Idaho and is used almost exclusively. The original Scribner rule, developed by J. M. Scribner well over a century ago, was based on a series of diagrams in which circles represented small-end diameters of logs; and lines across the circles represented the ends of 1-inch boards, allowing ¼-inch for saw-kerf between boards. As many boards as possible were fitted into the diagrams with a specified minimum width of board and a reasonable amount of slab. From these diagrams, the contents in board feet were then calculated for logs of various lengths and

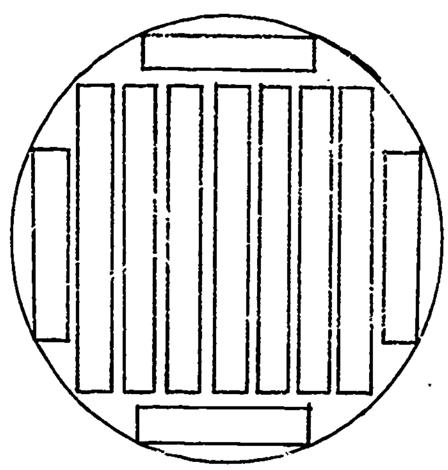


Figure 1.—Diagram showing the number of 1-inch boards that can be cut from a log of a specified diameter.

diameters. Figure 1 shows the type of diagram upon which the Scribner rule is based.

In the course of time, however, the original Scribner rule was modified to the Scribner decimal C rule, now in use. The modification consisted of rounding off all board foot measurements to the nearest 10 board feet and dropping the cipher. For example, if a log measured 802 board feet by the original Scribner rule, the Scribner decimal C rule would round to the nearest 10 (800) and drop the cipher, giving a result of 80. This 80 is shown in the decimal C log rule and is recorded in the scale book for convenience only. According to Scribner decimal C rule, the actual board footage would be 800 board feet. When the board foot columns in the scale book are summed up, the cipher is added to the total.

For the convenience of the scaler, figures from the log rule have been transferred to a scalestick which is used to measure diameters of logs. Scalestick markings show board footage for logs of various lengths and diameters.

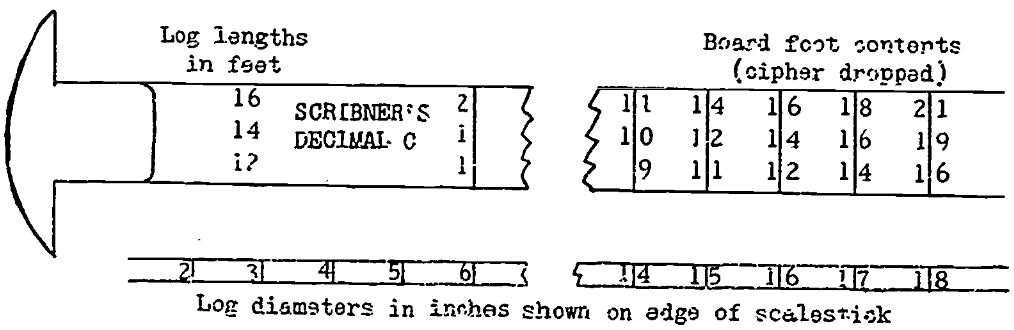


Figure 2.—Section of scalestick.

In using the scalestick, the scaler reads the board foot contents shown at the diameter line for a log of given length. For instance, for a 16-foot log with a 15-inch diameter, the scalestick shows 14 (140 board feet with the cipher dropped); for a 14-foot log with an 18-inch diameter, the scale is 19 (190 board feet); for a 12-foot log with a 6-inch diameter, the scale is 1 (10 board feet).

The Coconino Scribner decimal C scalestick gives the same information as the scalestick in Figure 2; and, in addition, it gives computed deductions for squared defects based on the standard rule. Also, the board foot figures are given at the half-inch mark, thereby making it unnecessary for the scaler to decide whether to drop to the next lower inch or advance to the next higher inch in measuring diameters that do not fall on exact inch markings.

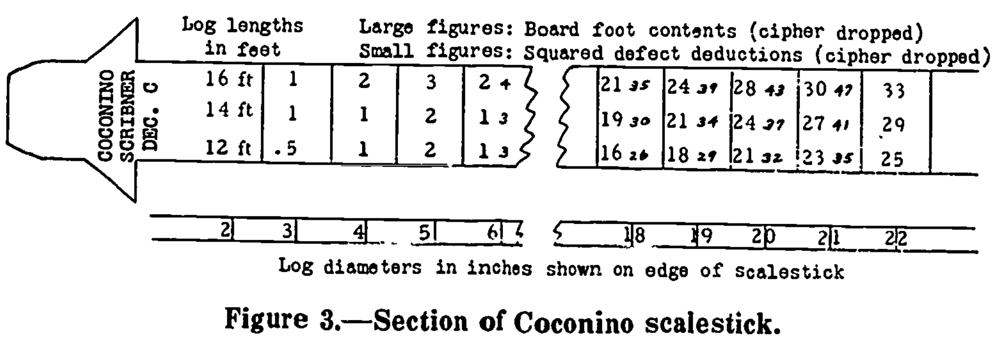


Figure 3.—Section of Coconino scalestick.

TABLE 1

SCRIBNER DECIMAL C LOG RULE

Diameter In Inches	Length in Feet									
	6	8	9	10	12	14	16	17	18	20
	Board Foot Contents in Tens									
6	0.5	0.5	0.5	1	1	1	2	2	2	2
7	0.5	1	1	1	2	2	3	3	3	3
8	1	1	1	2	2	2	3	3	3	3
9	1	2	2	3	3	3	4	4	4	4
10	2	3	3	3	3	4	6	6	6	7
11	2	3	3	4	4	5	7	7	8	8
12	3	4	4	5	6	7	8	8	9	10
13	4	5	5	6	7	8	10	10	11	12
14	4	6	6	7	9	10	11	12	13	14
15	5	7	8	9	11	12	14	15	16	18
16	6	8	9	10	12	14	16	17	18	20
17	7	9	10	12	14	16	18	20	21	23
18	8	11	12	13	16	19	21	23	24	27
19	9	12	13	15	18	21	24	25	27	30
20	11	14	16	17	21	24	28	30	31	35
21	12	15	17	19	23	27	30	32	34	38
22	13	17	19	21	25	29	33	35	38	42
23	14	19	21	23	28	33	38	40	42	47
24	15	21	23	25	30	35	40	43	45	50
25	17	23	26	29	34	40	46	49	52	57
26	19	25	28	31	37	44	50	53	56	62
27	21	27	31	34	41	48	55	58	62	68
28	22	29	33	36	44	51	58	62	65	73
29	23	31	35	38	46	53	61	65	68	76
30	25	33	37	41	49	57	66	70	74	82
31	27	36	40	44	53	62	71	75	80	89
32	28	37	41	46	55	64	74	78	83	92
33	29	39	44	49	59	69	78	83	88	98
34	30	40	45	50	60	70	80	85	90	100
35	33	44	49	55	66	77	88	93	98	109
36	35	46	52	58	69	81	92	98	104	115
37	39	51	58	64	77	90	103	109	116	129
38	40	54	60	67	80	93	107	113	120	133
39	42	56	63	70	84	98	112	119	126	140
40	45	60	68	75	90	105	120	128	135	150
41	48	64	72	79	95	111	127	135	143	159
42	50	67	76	84	101	117	134	143	151	168
43	52	70	79	87	105	122	140	148	157	174
44	56	74	83	93	111	129	148	157	166	185
45	57	76	85	95	114	133	152	161	171	190

TABLE 1—Continued

Diameter In Inches	Length in Feet: 6	8	9	10	12	14	16	17	18	20
	Board Foot Contents in Tens									
46	59	79	89	99	119	139	159	169	178	198
47	62	83	93	104	124	145	166	176	186	207
48	65	86	97	108	130	151	173	184	194	216
49	67	90	101	112	135	157	180	191	202	225
50	70	94	105	117	140	164	187	199	211	234
51	73	97	110	122	146	170	195	207	219	243
52	76	101	114	127	152	177	202	215	228	253
53	79	105	118	132	158	184	210	224	237	263
54	82	109	123	137	164	191	218	232	246	273
55	85	113	127	142	170	198	227	241	255	283
56	88	118	132	147	176	206	235	250	264	294
57	91	122	137	152	183	213	244	259	274	304
58	95	126	142	158	189	221	252	268	284	315
59	98	131	147	163	196	229	261	278	294	327
60	101	135	152	169	203	237	270	287	304	338
61	105	140	158	175	210	245	280	298	315	350
62	108	145	163	181	217	253	289	307	325	362
63	112	149	168	187	224	261	299	317	336	373
64	116	154	174	193	232	270	309	329	348	387
65	119	159	179	199	239	279	319	339	358	398
66	123	164	185	206	247	288	329	350	370	412
67	127	170	191	212	254	297	339	360	381	423
68	131	175	197	219	262	306	350	371	393	437
69	135	180	203	226	271	316	361	384	406	452
70	139	186	209	232	279	325	372	395	419	465
71	144	192	215	240	287	335	383	407	430	478
72	148	197	222	247	296	345	395	419	444	493

In scaling logs with diameters larger than those shown on either the Scribner decimal C or the Coconino scalesticks, or if a scalestick is not readily available or for some other reason an impromptu scale must be made, the scaler may record the length and diameter of the log and consult the log rule later; or he may use one of the following *rules of thumb* to compute the board footage:

1. KNOUF'S RULE

$$V=\frac{(D^2-3D)}{10}\times\tfrac{1}{2}L$$

When: V=Board foot volume of log
D=Diameter in inches (inside bark)
L—Length in feet

Square the average diameter of the small end of the log, subtract three times the diameter, divide the result by 10 and multiply by one-half the length of the log. Point off the right-hand figure. For example, if a log is 16 feet long and has an average small-end diameter of 40 inches:

$$V=\frac{(40^2-(3\times40)}{10}\times(\tfrac{1}{2}\times16)$$

$$V=\frac{1600-120}{10}\times8$$

$$V=\frac{1480}{10}\times8$$

$$V=148\times8$$

$$V=1184$$

By rounding the volume, 1184 board feet, to the nearest 10 board feet and by dropping the cipher, a scale of 118 decimal C is recorded.

2. WESTERN PINE ASSOCIATION RULE

This rule may be *used only* for 16-foot logs with diameters of 30 inches or more.

$$V=\frac{D^2\times\tfrac{3}{4}}{10}$$

When: V=Board foot volume of log.
D=Diameter in inches (inside bark)

Using the same example as was used with Knouf's rule above:

$$V=\frac{(40)^2\times\tfrac{3}{4}}{10}$$

$$V=\frac{1600\times\tfrac{3}{4}}{10}$$

$$V=\frac{1200}{10}$$

$$V=120 \text{ decimal C}$$

To obtain the volume of shorter logs, use the fractional method. For example, a 12-foot log, 40 inches in diameter, would be three-fourths of 120, or 90 board feet.

3. LOG DECK INVENTORY

To obtain the scale of a deck of logs, measure the length of the deck, the height of the deck, and measure or estimate the length of the average log in the deck. Then multiply length by height by length of the average log by two-thirds; this will give the *cubic* foot contents of the deck. Multiply this result by 6.1 to get the *board* foot contents of the deck.

The formula is stated as follows:

(Height in feet) $\times$ (Length in feet) $\times$ (Length of the average log in feet) $\times\tfrac{2}{3}\times6.1$.

The figure 6.1 is the average board foot contents of a cubic foot of sawlogs in Idaho. In any particular operation, it may be necessary to raise or to lower the board foot-cubic foot ratio of logs, depending on whether the logs are larger or smaller than average.

In order to determine the board foot-cubic foot ratio for an individual operation, a deck of scaled logs can be checked against the formula given on preceding page.

This method gives the total gross scale only; it does not give volume by species. The results must be qualified by the percentage of defect and by the species.

4. SCRIBNER FORMULA RULE

For logs under 12 inches in diameter, volumes computed from the Scribner formula rule are more accurate than volumes computed from the Scribner decimal C rule, because no rounding off to the nearest 10 is done. For logs over 12 inches in diameter, volumes compare quite favorably with the Scribner decimal C rule. Volume for material under 5 inches in diameter is not computed, for it does not yield merchantable lumber.

$V = .79\ D^2 - 2D - 4$ When: V=Volume in board feet for 16-foot log
D=Diameter in inches (inside bark)

Applying the same example as that used with Knouf's rule and the Western Pine Association rule:

$$V = .79\ (40)^2 - 2(40) - 4$$

$$V = 1264 - 80 - 4$$

$$V = 1180 \text{ or } 118 \text{ decimal C}$$

For a 14-foot log, the volume is computed as 14/16 of 1180, or 103 decimal C.

Table 2 shows board foot volumes based on the Scribner formula rule.

TABLE 2

SCRIBNER FORMULA LOG RULE

Diameter In Inches	Length in Feet				
	8	10	12	14	16
	Board Foot Contents				
5	3	4	4	5	6
6	6	7	9	10	12
7	10	13	16	18	21
8	15	19	23	27	31
9	21	26	31	37	42
10	27	34	41	48	55
11	35	44	52	61	70
12	43	54	64	75	86
13	52	65	78	91	104
14	61	77	92	108	123
15	72	90	108	126	144

SCALING EQUIPMENT

Figure 4 shows the common working tools used by the log scaler.

1. SCRIBNER DECIMAL C CALIPER SCALESTICK. This tool is basically the same as the Scribner decimal C scalestick except that it has two prongs: One is stationary; the other will adjust to the diameter of the log. The caliper scalestick is used to scale logs which have been bucked, but not skidded or separated. It may also be used tc determine actual taper of logs of more than one scaling length.

2. SCRIBNER DECIMAL C SCALESTICK. This is a tool upon which the Scribner decimal C log rule has been transferred. Generally the scalestick has the scale for logs from 6 inches to 48 inches in diameter. Two types of scalesticks are used in Idaho: One for logs 6, 8, 10, 12, 14, and 16 feet in length with inches shown on both edges; the other for logs 8, 10, 12, 14, 16, 18, and 20 feet in length with inches shown on one edge only. The scalestick is usually of hardwood construction, although metal sticks are available.

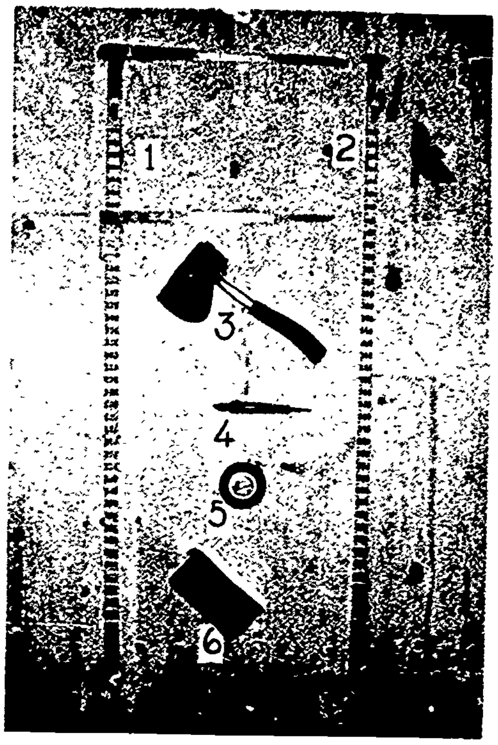


Figure 4.—Common working tools of the log scaler.

3. HATCHET. The belt-type hatchet is one of the most important tools in the scaler's equipment. The scaler uses this tool to determine the nature and extent of defects by sounding the log and/or chopping into the defect. Most scalers use a single-bitted, tempered hatchet with a durable belt scabbard.

4. COMBINATION CRAYON AND PENCIL HOLDER. This is usually made of hardwood and is built so that a lumber crayon (or keel) may be inserted in one end and a pencil in the other. The crayon is used for marking and numbering logs; the pencil is used for recording information in the scale book.

5. TAPE MEASURE. In checking log lengths, scalers generally use 50-foot steel tapes.

6. SCALE BOOK. The log scale and other required information is recorded in the scale book where it becomes a permanent record. Many types of books and forms are used in Idaho, the choice being determined by the organization for which the scaler works.

In addition to the common tools shown in Figure 4, the scaler may sometimes be required to use other equipment items such as: A scaling tape, water scale rule, various branding hammers, etc.

LOG MEASUREMENTS

Measuring is basic to scaling, and the scaler follows three procedures in arriving at the gross scale of a log.

He determines the log length in feet including trim allowance.

He determines the average scaling diameter, *small end, inside bark,* in inches.

From this combination of diameter and length, he arrives at the gross scale.

Gross scale is the total board foot contents of the scaling cylinder of the log before deductions for defects have been made. The scaling cylinder is an imaginary cylinder extending the length of the log. The diameter of this cylinder is identical to the small end diameter of the log, as shown in Figure 5.

Volumes given in the Scribner decimal C log rule and on the scalestick are the gross board foot contents of the scaling cylinder of the log.

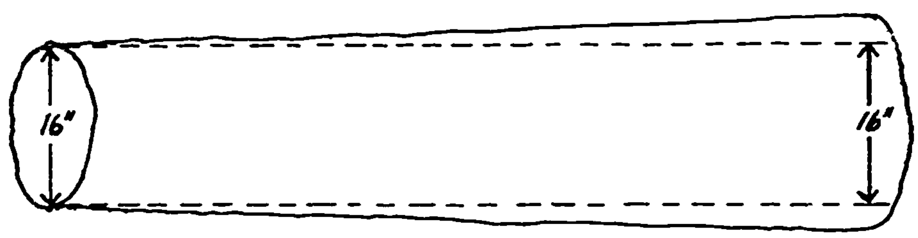


Figure 5.—Scaling cylinder of a log.

1. LENGTHS

Log lengths, as previously stated, are expressed in feet. Timber sales contracts or employers' instructions usually specify the maximum length of logs that may be scaled as one log. Logs exceeding this specified maximum length should be scaled as two or more logs as nearly the same length as practicable. If it is necessary to divide a log into unequal lengths, the butt log should be the longest. A trim allowance is permitted for each log length. Timber sales agreements usually specify trim allowance.

In the absence of other instructions, the following will apply:

a. Trim allowance for each scaling length shall be 6 inches, and shall not be included in the gross scale.

b. Logs up to 20 feet shall be scaled as one log.

c. Logs 22 feet to 32 feet inclusive shall be scaled as two logs.

d. Logs 34 feet to 48 feet inclusive shall be scaled as three logs.

e. Logs 50 feet to 64 feet shall be scaled as four logs.

2. TAPER

Although appearing truly cylindrical, most logs are tapered from butt to top; however, the scaler should bear in mind that some logs have little or no taper.

As a rule, the taper that does exist is greater in top and butt logs and less in logs from the center of the tree. The amount of taper may also vary with the species and with growing conditions.

When long logs are scaled as two or more shorter lengths, the scaler must have some method of determining taper and scaling diameters of the uncut logs. This may be done in any one of the following ways:

a. By means of a caliper scalestick, making allowance for the thickness of the bark. If the log is scalped, actual measurement can be taken.

b. By measuring the actual diameters of both ends of logs (other than butt cuts) and distributing the difference as evenly as possible among the scaling lengths. Actual taper measurements of each log length should be taken whenever possible.

For example, a 36-foot log with a 20-inch diameter on the scaling end and a 25-inch diameter on the large end has a total taper of 5 inches. Because a 36-foot log is scaled as three 12-foot lengths, the 5 inches of taper must be divided as evenly as possible among the three log lengths. Five divided by three is one and two-thirds; one and two-thirds added to the 20-inch scaling diameter to determine the scaling diameter of the second log gives 21 and two-thirds inches; as the two-thirds is over the half-inch, the scaling diameter of the second log is raised to the next higher inch, or 22 inches. This 22 inches subtracted from the 25-inch diameter on the large end of the log leaves 3 inches taper to be divided between the two remaining logs; three divided by two is one and one-half inches; the half-inch is dropped, making the scaling diameter of the third log 23 inches.

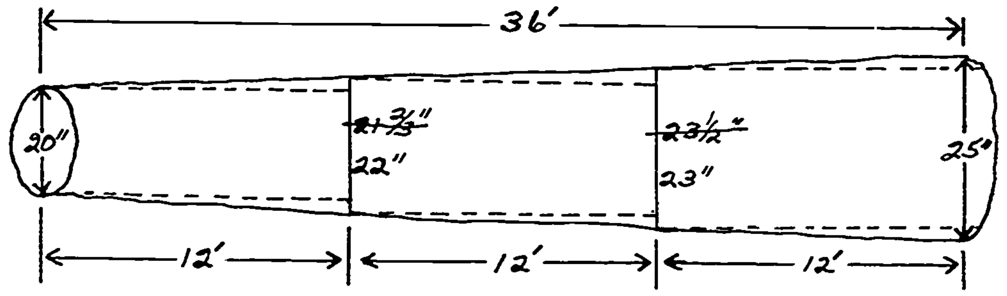


Figure 6.—Diagram illustrating scaling lengths and taper allowances for a 36-foot log according to method b.

c. By means of the following taper table, which is intended to serve only as a guide and *should never* be used when actual taper can be measured. In no case should the scaler allow for taper if taper does not exist.

TABLE 3

TAPER GUIDE FOR LOGS WITH TWO OR MORE SCALING LENGTHS

Total Length Of Log	Scaling Lengths and Taper Allowances				
	Top Log Length	Second Log Length	Increase Second Log Diameter Over Top Log Diameter	Third Log Length	Increase Third Log Diameter Over Second Log Diameter
22 feet	10 feet	12 feet	1 inch	......	....
24 feet	12 feet	12 feet	1 inch	......	....
26 feet	12 feet	14 feet	1 inch	......	....
28 feet	14 feet	14 feet	1 inch	......	....
30 feet	14 feet	16 feet	1 inch	......	....

32 feet	16 feet	16 feet	2 inches	......	....
34 feet	10 feet	12 feet	1 inch	12 feet	1 inch
*36 feet	12 feet	12 feet	1 inch	12 feet	1 inch
38 feet	12 feet	12 feet	1 inch	14 feet	1 inch
40 feet	12 feet	14 feet	1 inch	14 feet	1 inch
42 feet	14 feet	14 feet	1 inch	14 feet	1 inch
44 feet	14 feet	14 feet	1 inch	16 feet	1 inch
46 feet	14 feet	16 feet	1 inch	16 feet	2 inches
48 feet	16 feet	16 feet	2 inches	16 feet	2 inches

*For example, if a 36-foot log has a 20-inch diameter at the top or scaling end, the diameter of the second log would be calculated with an increase of 1 inch over the scaling diameter of the top log, or 21 inches; and the diameter of the third log would be calculated with an increase of 1 inch over the scaling diameter of the second log, or 22 inches.

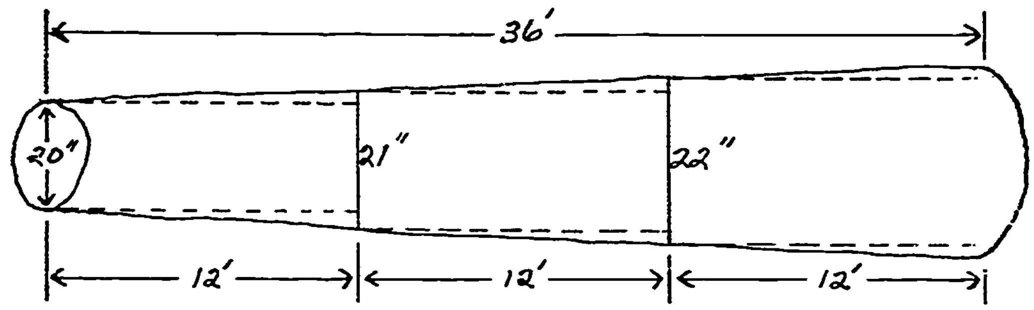
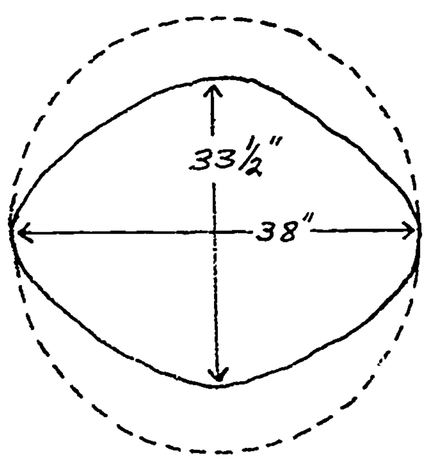


Figure 7.—Diagram illustrating scaling lengths and taper allowances for a 36-foot log according to Table 3.

3. DIAMETERS

As previously stated, log diameters are always expressed in inches and are taken at the small end of the log. They are obtained by placing the scalestick or tape across the small end of the log and by reading the diameter of the wood cylinder, excluding the bark.

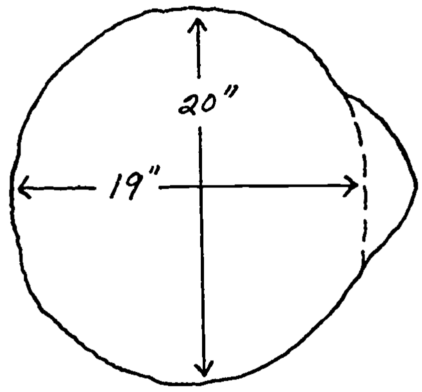
Logs are scaled to the average diameter; in some cases it may be necessary to take more than two measurements to obtain a fair average diameter. A second measurement taken at right angles to the first measurement will usually give an accurate average. For example, if one diameter measurement is 38 inches and a second measurement is 33½ inches, the average diameter is 35¾ inches. Average diameters are rounded off to the nearest inch above or below the actual diameter. Diameters which are exactly halfway between inches are dropped to the next lower inch.



38 first diameter measurement

33½ second diameter measurement

71½÷2=35¾, which would be scaled as a 36-inch diameter.



If the scaling end of a log has a swelling or depression, a suitable reduction or increase in diameter should be made.

20 first diameter measurement

19 second diameter measurement

$39 \div 2 = 19\frac{1}{2}$, which would be scaled as a 19-inch diameter.

Figure 8.—Sketches showing methods of determining the average diameter of a log.

4. ODD- OR UNCOMMON-LENGTH MATERIAL

Practices in the scaling of odd- or uncommon-lengths of logs vary according to individual companies' needs and policies.

In order to standardize the scaling of odd- or uncommon-length material, the following are suggested:

a. Trim allowance for sawlogs

(1) Odd-length sawlogs up to and including 19 feet should be allowed a trim of 6 inches.

(2) Odd-length logs up to and including 19 feet cut with more than 6-inch trim should be scaled to the next higher foot. For example, a log measuring 17 feet 9 inches should be scaled as an 18-foot log.

(3) Odd-length logs over 20 feet in length should be allowed a 1-foot trim.

(4) Odd-length logs over 20 feet in length cut with more than 1-foot trim should be scaled to the next higher foot.

b. Trim allowance for peeler logs.

Peeler logs should be cut with a 9-inch trim for each 8-foot peeler block. This is necessary because of the large diameters of peeler logs, which often cause the saw cut to run crooked. Because this 9-inch trim is over the 6 inches allowed on each 8-foot length, it is necessary to scale the block as 9 feet. To arrive at this figure on the rule, the scaler either takes half of the 18-foot scale or splits the difference between the 8- and 10-foot scale. The combination of two 8-foot veneer blocks, each with 9-inch trim, would make an over-all length of 17 feet 6 inches. This would be scaled as a 17-foot log.

c. Tie Timber

Mainline railroad ties are cut 8½ feet in length, plus trim. Double lengths, or 17-foot logs, with proper trim allowance, are cut in general practice. Such logs are scaled as 17 feet.

MERCHANTABILITY

A merchantable log is one which contains enough sound wood to warrant the manufacture of lumber, pulp, veneer, or other salable products. Timber sale agreements usually include a merchantability clause, which details the specifications for merchantable timber; but, *in instances where no specifications for merchantability have been established*, the following rules are applicable:

1. All white pine and ponderosa pine must be at least 33⅓ per cent sound.
2. All other species must be at least 50 per cent sound.
3. In white pine and ponderosa pine, merchantable minimums are 8-foot log lengths and 6-foot lumber lengths.
4. In other species, merchantable minimums are 10-foot log lengths and 8-foot lumber lengths.
5. Minimum scaling diameter in white pine is 6 inches.
6. Minimum scaling diameter in ponderosa pine and other species is 8 inches.
7. Minimum net volume in any one scaling length in white pine is 10 board feet.
8. Minimum net volume in any one scaling length in ponderosa pine and other species is 20 board feet.
9. Minimum width for merchantable boards is 4 inches.
10. *Each individual scaling length is considered on its own merit.* When logs, bucked in multiples of one scaling length for logging convenience, are to be divided into shorter lengths at the mill, the scaler considers each scaling length individually. For example, if one 16-foot length of a 32-foot log is a cull, only the net scale of the sound 16-foot length should be recorded.

NUMBERING AND LETTERING OF LOGS

In lieu of other instructions, every log, whether merchantable or cull, should be given a number which corresponds with the log number in the scale book being used. Also, an identifying mark or letter should be put on the opposite end of each log to indicate the book in which the scale is recorded. Some scalers may be required to use additional log markings.

In scaling logs on decks, landings, trucks, etc., all logs should be numbered on one end of the deck, regardless of whether log ends are butt or top. This will give assurance that no logs are missed or are scaled more than once. The proper identification of logs contributes greatly to efficient check scaling and also provides information on totals of logs scaled.

OVERRUN AND UNDERRUN

Overrun is the amount that the surfaced product in board feet, according to lumber tally, exceeds the log scale recorded by the scaler. Underrun is the amount that the surfaced product falls short of the log scale. The amount of lumber that can actually be cut from a log of any given size varies because of mechanical and economic factors that affect manufacturing processes. Mills sometimes experience as much as 10 to 15 per cent overrun or underrun. *Under no circumstances should the scaler make allowance for overrun or underrun which is known to exist.* He should scale each log on its own merits and according to standard practices.

Some factors influencing overrun and underrun which may be of interest to the scaler are:

1. Accuracy of the scaler in deducting for defects.
2. Saw-kerf. Scribner's rule allows for a ¼-inch kerf. Less than ¼-inch kerf may result in overrun; more than ¼-inch kerf may result in underrun.

3. Thickness of the boards. Cutting dimension and timbers usually results in less loss from saw-kerf, thereby resulting in greater overrun.
4. Width of the boards. If boards narrower and thinner than specified in Scribner's rule can be used, it is possible to cut more boards than the log scale shows.
5. Skill of the sawyer. The skillful sawyer wastes nothing but the necessary slab and kerf.
6. Efficiency of the machinery.
7. Milling loss.
8. Amount of taper. Greater taper will allow for short boards to be cut from outside the scaling cylinder.
9. Log size. Small logs may result in overrun, and large logs may result in underrun.

RECORDS AND REPORTS

Many different types of forms are used for recording and reporting log scale. The scaler will be instructed by his employer as to the procedures required by him for the filling out of forms. The following points are important for the scaler to remember.

1. Use only those forms provided for the specific purpose. Do not record scale on loose slips of paper without permission. Such temporary records should be transferred to the scale book as soon as practicable, and the temporary record fastened permanently to the page of the scale book on which the entries are made.
2. Fill out records completely. Spaces provided for scaler's name, sale name or number, date, landing, etc., must be filled out in full.
3. Records and reports must be legible. Errors should be lined out rather than erased.
4. Each log must be accurately recorded in the species column. Entry of a log in the wrong species column is misidentifying the log. Log numbers must correspond to the serial numbers in the book.
5. The scaler should guard against the loss or mutilation of his scale book.
6. The employer will instruct the scaler as to the frequency with which he wishes reports to be submitted.

NONUTILIZATION OR PENALTY SCALING

Nonutilization or penalty scale is based upon the seller's measurement of sound material that the timber purchaser has consistently failed to utilize. *The seller should not record and report nonutilization or penalty scale in a combined figure with the regular scale*, but he should show it as a separate figure and indicate the area in which the error occurred. If this is done, the purchaser can then pinpoint the instances of poor utilization and improve his methods of operation accordingly.

Cases of poor utilization are generally detected in the woods, rather than at the point of scaling. In public agency contracts the officer in charge is required to notify the purchaser in writing of the waste in sound material; in other instances, it may be the scaler's responsibility to notify his employer of poor utilization. Industrial foresters, woods foremen, scalers, check scalers, and "bullbucks" should be aware of poor log-making practices in order to avoid nonutilization scale application.

Some common instances of waste are as follows:

1. *Failure to cut to the top diameter prescribed by contract.*
2. *High stumps.* Maximum allowable stump height is usually 12 inches on pine and 14 inches on mixed species above the highest adjacent ground. Timber contracts generally prescribe the method by which high stumps shall be treated in nonutilization or penalty scale. When high stumps are excessive in number, common practices are to make a flat rate charge for each stump or to compute to the nearest board foot the actual loss of material.
3. *Excessive trim allowance.* If logs are consistently cut with longer than specified trim allowance, they should be scaled to the next foot in length and recorded separately as nonutilization or penalty scale.
4. *Excessive long-butting.* Sound material left in a long butt should not exceed 33⅓ per cent in pine or 50 per cent in other species. Sound material left in long butts in excess of these established amounts is subject to nonutilization scale.
5. *Sound material on cull logs and breaks.* If excessive sound material left on cull logs and breaks can be utilized by increasing the length of the adjoining log, such material will be subject to nonutilization scale
6. *Merchantable trees left standing.*

CHECK SCALING

Check scaling, as the title implies, is the scaling of materials that have been previously scaled in order to verify the accuracy of the original scale. Systematic check scaling is an essential operation for any organization which purchases, sells, stores, or manufactures logs, poles, posts, pulpwood, etc. The primary purpose of check scaling is to identify sources of error that affect the net log scale; in addition, check scaling assists in accomplishing the following objectives:

To attain a more uniform scale.

To aid in training a new scaler.

To check the quality and quantity of the work of a scaler or any organization dealing in timber products.

To check the accuracy of reports.

Mill lumber tallies should never be used to check the accuracy of scaling.

In check scaling for training purposes, the check scaler should scale and record from 100 to 300 logs, which have been previously scaled and numbered. The species, log number, length, diameter, defect, and net scale should be recorded in the check scale book. The total scale or the scale of individual logs by the trainee and by the check scaler can then be accurately compared. Check scaling for training purposes should be done with the trainee under the same conditions as the original scale. Any differences may then be brought to the trainee's attention and further instruction may be given him.

In check scaling an experienced scaler, a common practice is for the scaler or inspector to make the check at a different location and without the scaler's knowledge. For purposes of comparison and future reference, complete information is recorded: The forest area; sale and designation; sale brand numbers; date of check scale; scaler; check scaler; species; amount of defect; book letter; log number; length; diameter; grade; full scale; inspector's scale;

scaler's scale; difference in species identification; difference in scale—both plus and minus—by individual logs; and name and character of defects by symbols or similar means.

In order to check scale logs that are on gondolas, trucks, rollways, etc., it is necessary to scale each log in the unit and to record all available information: Total number of pieces, car number, date of loading, driver of truck, gross scale, volume by species, and number of pieces by species. These results can then be compared with records kept by the scaler.

In check scaling a boom of logs in the water, it is necessary to rescale the entire boom and to record the scale of each log as to length, diameter, and species. Volume by species can then be compared with the original scale.

The check scaler's results are always taken as the basis for calculating per cent of error. This standard includes the accuracy of the gross scale, net scale, classification of defects—mechanical, interior and exterior—identification of species, scale computation, and the recording of scale information. The scaler is rated according to the percentage of variation, either plus or minus, between his scale and that of the check scaler. If considerable error in the scaler's work is evident or if it is necessary to reject the work entirely, a series of rechecks should be made, with reasonable time between rechecks, until the work is acceptable.

Table 4 is sometimes used as a guide in determining a scaler's accuracy. The table shows percentage of log defect, inasmuch as this has a direct relationship to the variation between the check and original scales.

TABLE 4

STANDARDS OF ACCURACY AS SHOWN IN PERCENTAGES OF VARIATION (PLUS OR MINUS) BETWEEN CHECK AND ORIGINAL SCALES

Logs	Excellent	Good	Fair	Poor
Sound or gross	.5%	1.0%	1.5%	2.0% and over
0 to 10% defective	.5%	1.5%	2.0%	3.0% and over
11 to 20% defective	1.5%	2.0%	3.0%	4.0% and over
Over 20% defective	3.0%	4.0%	5.0%	5.5% and over

When a scaler's work falls below "good," it is recommended that he be given additional training, be rechecked within one week, and be periodically rechecked thereafter until the quality of his work is acceptable.

The check scaler, in addition to being an expert on sawlog scale, should be well-versed in the following:

1. Various methods of nonutilization or penalty scaling and in the proper and fair application, recording, and reporting of such scale.
2. Obtaining the proper information by scaling from the stump, when assigned to timber trespass cases.
3. Tree measurement method of selling timber and methods of check scaling such operations.
4. Interpretation of log grades that have been standardized by the buyer and seller.
5. Checking the accuracy of records concerning the measurement of forest products other than sawlogs such as: Poles, posts, pulp, Christmas trees, etc.

Camp or Sale Camp 61 State Sale #1732 Date 5-20-59

Scaler John Jones

Brand	No.	Lth.	Sp.	Full	Ins.	Sc.	Brand	No.	Lth.	Sp.	Full	Ins.	Sc.	
Sound Logs							Defective Logs							
D	1972	32	WP	32		32	D	1938	16	WF	14	11	12	R
D	1965	32	WP	45		45	D	1945	32	SP	30	29	30	BB
D	1929	36	WF	37		39	D	1944	32	SP	39	37	39	LD
D	1939	32	WP	30		30	D	1942	32	WP	27	26	25	BB
D	1947	26	SP	17		14	D	1924	32	WP	30	24	26	R
D	1959	32	WP	24		24	D	1958	36	WF	27	23	22	Sh
D	1971	36	RF	29		31	D	1960	36	WF	31	28	28	Ch
D	1908	26	WP	7		7	D	1937	36	RF	31	24	25	MP SW
D	1907	32	WP	27		25	D	1978	32	WP	45	39	39	R
D	1951	32	WP	24		24	D	1902	32	WP	24	21	21	R
D	1811	32	SP	21		21	D	1897	36	WF	31	29	32	Sh
D	1883	32	WP	49		52	D	1901	32	WP	13	11	11	FB
D	1887	16	WP	66		66	D	1898	32	WP	14	13	14	CR
D	1903	18	WF	65		62	D	1884	32	WP	21	20	22	Y
D	1910	32	WP	54		54	D	1911	32	WP	25	22	22	R
D	1904	32	L	39		39	F	38	32	SP	25	24	23	Ch
D	1909	36	RF	17		17	F	8	36	WF	42	39	37	Sh
F	69	16	L	58		58	F	48	18	WF	18	17	18	Ch
F	68	16	WP	46		50	F	19	32	WP	58	43	45	R
G	16	16	WP	61		61	F	20	16	WP	61	60	58	R
G	9	34	WF	29		29	F	37	36	WF	69	60	63	Sh
F	47	32	WP	9		9	G	13	16	L	58	44	46	Sh
F	43	18	WF	42		42	G	17	26	WF	8	7	6	R
F	39	32	WP	11		11	G	12	36	WF	31	28	27	Ch
F	18	28	RF	9		9	G	6	32	WP	34	33	34	R
						851							736	1577
					848							712		1560
				848							806			1654

Figure 9.—Sample page from check scale book.

The sample page illustrated in Figure 9 provides space for sound logs, defective logs, and species.

Memorandum of Check Scale on John James (Camp 61)

Clearwater Unit Landings Camp or Sale State Sale #1732 Date 5-20-59

Species	Logs	Scale in Board Feet			Difference		Defect		Miscellaneous
		Full	Ins.	Scaler	Feet	Per Cent	Feet	Per Cent	
Total Sound	25	8.480	8.480	8.510	+30	+0.35	—	—	
Total Defective	25	8.060	7.120	7.260	+140	+1.97	940	11.66	
GRAND TOTAL	50	16.540	15.600	15.770	+170	+1.09	940	5.68	

Taylor
Inspector

Figure 9a.—Check scale recapitulation page.

The sample page shown in Figure 9a is for use with the check scale book illustrated in Figure 9.

IV IDENTIFICATION OF TREE SPECIES

The ability to identify logs by species is extremely important to the scaler because of the wide differences in value of the various species; for example, a white pine log may be worth several times as much as a white fir or hemlock log of equal volume. Consequently, consistent errors in species identification by a scaler may result in considerable financial loss to the buyer or the seller. Through study and properly supervised experience, however, the scaler should develop skill in accurate species identification in a short time.

The problem of species identification in Idaho is somewhat involved because of the number of commercial species that occur in the state. In any given area or operation the number of species that the scaler must identify may be half a dozen or more. Most of the commercial species are conifers, with the following ten considered to be those of major importance:

IWP	Western or Idaho white pine	*Pinus monticola*
PP	Ponderosa pine	*Pinus ponderosa*
ES	Engelmann spruce	*Picea engelmanni*
C	Western redcedar	*Thuja plicata*
L	Western larch or tamarack	*Larix occidentalis*
DF	Douglas fir or red fir	*Pseudotsuga menziesii*
WF	White fir or grand fir	*Abies grandis*
AF	Subalpine fir	*Abies lasiocarpa*
H	Western hemlock	*Tsuga heterophylla*
LPP	Lodgepole pine	*Pinus contorta*

In addition to the ten species listed above, a few other conifers occur in Idaho. They are of little commercial importance because of their scrubby growth habit, inaccessibility, or widely scattered distribution. These include:

Limber pine	*Pinus flexilis*
Whitebark pine	*Pinus albicaulis*
Mountain hemlock	*Tsuga mertensiana*
Rocky Mountain juniper	*Juniperus scopulorum*
Western juniper	*Juniperus occidentalis*
Utah juniper	*Juniperus osteosperma*
One-seed juniper	*Juniperus monosperma*
Pacific yew	*Taxus brevifolia*

Hardwoods are of little importance as timber trees in Idaho. The four listed here are sometimes used for fence-posts, fuelwood, pulp, veneer cores, or other secondary forest products. They are:

Quaking aspen	*Populus tremuloides*
Black cottonwood	*Populus trichocarpa*
Paper birch	*Betula papyrifera*
Thinleaf alder	*Alnus tenuifolia*

Generally speaking, the scaler depends largely on bark characteristics and the color and amounts of sapwood and heartwood for identification purposes. In paper mills and in sawmills where edgings, trimmings, and other materials are made into chips for pulp manufacture, scalers must be able accurately to identify barked logs. Under these conditions, identification is much more difficult; and the scaler must depend largely on color and relative amounts of heartwood and sapwood, presence of pitch, and size and distribution of knots as the bases for his identification.

In the species descriptions that follow, the characteristics of bark, sapwood, heartwood, and barked logs are given first, as these are the ones generally used by the scaler on the job; in addition, foliage and cones or fruit characteristics are also given. Although these are usually not available as aids in identification in scaling practice, they will help the scaler in identification of standing or fallen timber in the woods. This ability will, in turn, make the job of identifying logs much easier.

In using bark characteristics for identification of logs, the scaler must keep in mind that, in many species, the bark on young trees may be very different in color and texture from the bark on older or mature trees. Logs cut from the lower boles of older trees may also have different bark characteristics than those cut from the upper boles. These differences are pointed out in the descriptions given in this chapter.

Some general groupings that simplify the problem of species identification in logs are as follows:

1. Species with scaly or plated bark on mature trees.
   - Western white pine
   - Ponderosa pine
   - Engelmann spruce
   - Western larch
   - Lodgepole pine
   - Limber pine
   - Whitebark pine
2. Species with deeply furrowed bark on mature trees.
   - Douglas fir
   - White or grand fir
   - Western hemlock
3. Species with stringy, fibrous bark on mature trees.
   - Western redcedar
   - Junipers
4. Species with dark-colored, distinct heartwood.
   - Western redcedar
   - Western larch
   - Douglas fir
   - Junipers
5. Species with light-colored heartwood and little or no contrast between heartwood and sapwood.
   - Western white pine
   - Ponderosa pine
   - Engelmann spruce
   - Grand fir
   - Subalpine fir
   - Western hemlock
   - Lodgepole pine
6. Species with pitchy sapwood.
   - Western white pine
   - Ponderosa pine
   - Engelmann spruce
   - Douglas fir
   - Lodgepole pine

The descriptions of species that follow are designed to give the features of greatest value in scaling practice. As previously mentioned, foliage and cone or fruit characteristics are also given. An effort has been made to list all printable common names in use in Idaho for each species.

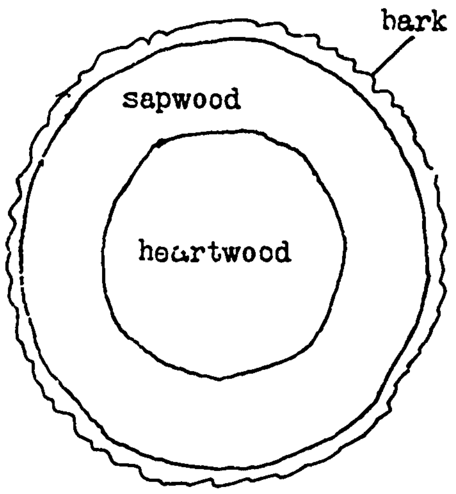


Figure 10.—Sketch showing heartwood, sapwood and bark.

1. WESTERN WHITE PINE (*Pinus monticola*). Also called Idaho white pine or white pine.

BARK—The bark on young trees is usually smooth and light gray-green in color; and on old trees it is ¾ inch to 1½ inches thick and is divided into small, nearly square plates by deep lengthwise and crosswise fissures covered by small, thin or closely appressed purplish-gray scales.

SAPWOOD—The sapwood is light cream to light brown or reddish-brown color, soft, and from ½ inch to 3 inches thick. In decked logs the sapwood is often almost indistinguishable from heartwood. A conspicuous exudation of pitch (resin) is visible in the sapwood on the ends of logs.

HEARTWOOD—The heartwood is cream-colored or pale brownish to light reddish-brown. It is soft, straight-grained, and has a slightly pitchy or resinous odor.

FOLIAGE—Needles are borne in bundles of five, 2 to 4 inches long, and blue-green in color.

CONES—Cones are 6 to 10 inches long and cylindrical. They have curved thin scales, usually with conspicuous drops of resin.

BARKED LOGS—Pitch exudation on the sapwood, coupled with the light heartwood, and a whorled arrangement of small knots are typical of white pine.

2. ENGELMANN SPRUCE (*Picea engelmanni*). Also called spruce.

BARK—The bark is from ¼ to ½ inch thick, usually light purplish-gray to orange-brown in color, and broken into large, thin, loose scales.

SAPWOOD—The sapwood is 2 to 4 inches thick, pale yellow to pale yellow-brown in color, and may be slightly pitchy.

HEARTWOOD—The heartwood is usually about the same color as the sapwood, sometimes slightly darker. As a rule, it is extremely difficult to differentiate between heartwood and sapwood.

FOLIAGE—The blue-green needles are borne singly and are usually about 1 inch long. They are moderately stiff and sharp-pointed; crushed needles have a pungent odor.

CONES—The cones are about 2 inches long, narrowing at the ends. They are light brown in color and have thin, papery scales.

BARKED LOGS—Resinous sapwood and the lack of sharp contrast between heartwood and sapwood characterize Engelmann spruce logs.

Figure 11. --Western White Pine.

Figure 12.—Engelmann Spruce.

3. PONDEROSA PINE (*Pinus ponderosa*). Also called bull pine, yellow pine, western yellow pine, and pondosa pine.

BARK—The bark on young trees (80 to 100 years old) is broken into scaly ridges covered with small, thin scales, dark reddish-brown to nearly black, and from ½ inch to 1½ inches thick. Young trees with this dark bark are often called bull pine. On older trees the bark is often from 2 to 4 inches thick and deeply and irregularly divided into plates, sometimes 4 to 5 feet long and 12 to 18 inches wide. These larger plates are covered with thick, yellow-brown to orange-brown irregular scales.

SAPWOOD—Young ponderosa or bull pine is 80 to 100 per cent sapwood. In older growth, the sapwood is usually 2 to 12 inches thick. This sapwood is cream-colored, and pitch exudation on the sapwood is usually conspicuous.

HEARTWOOD—The heartwood is yellowish to light reddish-brown and has a definite pitchy odor.

FOLIAGE—The needles are usually borne in bundles of three (sometimes two to five), 5 to 11 inches long, and dark green in color.

CONES—The cones are 3 to 6 inches long, round in outline, and have stiff, woody scales with a sharp prickle on the tip.

BARKED LOGS—Pitch exudation on the sapwood, conspicuous brown center pith, cream-colored wood, and large, bulging, scattered knots help to identify ponderosa pine logs.

Figure 13.
Ponderosa Pine — Old Growth

Figure 14.
Ponderosa Pine
Second Growth

4. WESTERN LARCH (*Larix occidentalis*). Also called tamarack or larch.

BARK—On young trees the bark is scaly and reddish-brown to purplish-brown. On older trees, it is deeply furrowed and broken into irregularly shaped plates, usually purple-gray in color, but sometimes brown to reddish-brown. Bark is relatively thick at all ages, being 4 to 6 inches thick on mature butt trunks. Larch bark, which may be confused with that of ponderosa pine, has a reddish-purple color under the scales in contrast to the yellow under the scales of ponderosa pine.

SAPWOOD—The sapwood is thin (¼ inch to 1 inch thick), nearly white to pale brown, and may be slightly pitchy.

HEARTWOOD—The heartwood is hard and heavy and is reddish-brown to dull brown in color. The contrast between heartwood and sapwood is distinct.

FOLIAGE—Needles are borne in dense clusters on small raised bumps on the twigs. They are 1 to 1½ inches long, thin, flexible, and light green in color. In the fall they turn bright yellow and then drop off. (This is the only conifer in Idaho that loses its needles.)

CONES—The cones are about 1 inch long and have rather stiff, thin, brown scales. A long, thin, pointed bract sticks out from the underside of each cone scale.

BARKED LOGS—The most readily distinguishable features are the sharp color contrast between the narrow band of sapwood and the heartwood, the resin exudation on the sapwood, and a tendency toward clustered knots. Ring shake and heart check are common on the ends of larch butts.

Figure 15.
Western Larch—Old Growth

Figure 16.
Western Larch
Second Growth

5. WESTERN REDCEDAR (*Thuja plicata*). Also called cedar.

BARK—The bark, light red-brown on young trees and gray-brown on old trunks, is thin (1 to 3 inches thick), and forms a network of long, thin, fibrous strips.

SAPWOOD—The sapwood is thin, nearly white, and non-resinous.

HEARTWOOD—The heartwood is soft and brittle, reddish-brown to pinkish-brown, and has a pungent, distinctive odor. The contrast between heartwood and sapwood is pronounced.

FOLIAGE—The leaves, borne in flattened groups of four, are very small and scale-like. The branchlets have a "fern-like" appearance and are dark, glossy green on the upper surface.

CONES—The cylindrical cones are small, light brown, and about ½ inch long. They have thin scales, few in number, and are borne upright in dense groups at the tips of the branches.

BARKED LOGS—The brash or brittle texture of the wood, the sharp contrast between sapwood and heartwood, and the stringy shreds of bark adhering to logs are identifiable characteristics.

6. DOUGLAS FIR (*Pseudotsuga menziesii* variety *glauca*). Also called red fir.

BARK—On young trees the bark is smooth, gray-brown, and broken by pitch blisters. On mature trees it gradually becomes corky and deeply furrowed. Mature bark, dark red-brown to a very light gray, usually shows a lighter, almost orange color deep in the furrows. The mature bark is 2 to 6 inches thick. Second growth bark is usually ½ inch to 2 inches thick.

SAPWOOD—The sapwood is pale yellow to reddish-cream color, rather narrow, and pitchy.

HEARTWOOD—The heartwood is hard and heavy and yellowish-brown to deep reddish-brown. The contrast between heartwood and sapwood is very distinct.

FOLIAGE—The needles—medium green to blue-green in color, ¾ inch to 1 inch long, flexible, and with rounded ends—are borne singly and are arranged all around the twig. The most notable feature of the foliage is the pointed, red-brown buds.

CONES—The cones are 2 to 3 inches long with thin, rounded, red-brown scales. A thin, papery, three-pointed bract extends from the underside of the scales.

BARKED LOGS—The sharply contrasting sapwood and heartwood and the pitchy sapwood are obvious characteristics. Pitch seams, pitch rings, and oozing pitch are common in this species.

Figure 17.
Western Redcedar

Figure 18.
Douglas Fir

7. GRAND FIR (*Abies grandis*). Also called white fir.

BARK—Young trees have smooth gray-green bark with numerous pitch blisters. Young trees begin to develop a furrowed, horny bark, which is up to 2 inches thick and is dark gray-brown to purple-gray in color on mature trees.

SAPWOOD—The narrow sapwood, light buff to yellowish-brown or pale reddish-brown, is not resinous; although some pitch from the inner bark may be present on the sapwood.

HEARTWOOD—The soft heartwood is not distinctively different in color from the sapwood, although it may be slightly darker. The summerwood portion of the annual rings may be faintly pinkish.

FOLIAGE—Needles are borne singly and those of the lower crown are arranged in flat rows along each side of the twig. They are about 1 to 2 inches long and are a dark glossy green on the upper side with whitish streaks on the under side. Crushed needles give off an aromatic odor.

CONES—The olive green, barrel-shaped cones are 2 to 4 inches long and are borne upright in clusters in the top of the tree. When the cones are ripe, the scales fall off. Resin droplets are noticeable on cones.

BARKED LOGS—The absence of resin exudation from the sapwood on ends of logs and the similarity in color of sapwood and heartwood are marked features. A dark water core is sometimes present and growth rings are conspicuous.

8. SUBALPINE FIR (*Abies lasiocarpa*). Also called alpine fir.

BARK—Similar to young grand fir but often with numerous horizontal rows of resin blisters. As the tree matures, the bark remains unfurrowed except in the lowest part of the trunk. Occasional mature trees have furrowed bark similar to grand fir.

SAPWOOD—The sapwood is thin and lighter-colored than the heartwood.

HEARTWOOD—The heartwood is soft, coarse-grained, and light brown or gray in color.

FOLIAGE—Needles, borne singly, are massed, brush-like, on the upper side of the twig. They are usually about ½ inch to 1 inch long, flexible, and gray-green and dull on the upper surface. Crushed needles have a distinct odor, somewhat like grand fir.

CONES—Cones are similar to grand fir, but they are smaller and dark purple in color.

BARKED LOGS—Helpful identifying features are scattered small knots and the evidence of down-turned limbs. The wood is soft to the touch and has a pungent odor.

Figure 19.
Grand Fir

Figure 20.
Subalpine Fir

9. WESTERN HEMLOCK (*Tsuga heterophylla*). Also called hemlock.

BARK—The bark on all ages of trees is thin. On young trees it is dark orange-brown to purple-brown and is broken into small, rounded scales; on mature trees, the bark has deep furrows between flat ridges, which are covered with close-set, dark brown to purple-gray scales. The underbark on hemlock of all ages is a bright red streaked with purple.

SAPWOOD—The sapwood is quite thin. The last few outer rings, sometimes almost white, are the only portion of the sapwood which may show any contrast to the heartwood. Usually there is little or no contrast between heartwood and sapwood.

HEARTWOOD—The heartwood is hard, tough, and closely-grained, usually a pale brown in color; but occasionally it may have a reddish or purplish cast, especially in the summerwood portion of the annual rings.

FOLIAGE—The needles are small and flat, ¼ inch to 1 inch long, and irregular in length. They are dark green on top and pale green with two white bands beneath.

CONES—The cones are small and rounded, up to 1 inch long with a few small, thin, brown scales.

BARKED LOGS—The absence of resin and lack of contrast between the brownish heartwood and sapwood are typical of western hemlock. A pitted surface is common in barked logs.

10. LODGEPOLE PINE (*Pinus contorta*). Also called jack pine and black pine

BARK—The bark on young trees is dark gray to almost black and very scaly. Bark on mature lodgepole pine differs in northern and southern parts of the State. In northern Idaho (western white pine region) the mature bark is made up of narrow ridges, broken into almost square or rectangular plates with the ridges separated by deep furrows; and the over-all color is almost black to dark gray. In the southern part of Idaho mature lodgepole pine bark is light brown or orange-brown to almost gray and is covered by thin, loose scales. Knocked-off scales reveal a greenish color where scales were attached.

SAPWOOD—The sapwood is narrow, nearly white to pale yellow in color. Often there is no easily discernible difference between heartwood and sapwood, though the sapwood is usually somewhat lighter in color. Pitch exudation is conspicuous on the sapwood.

HEARTWOOD—The heartwood is light yellow-brown to pale yellow or pale pink.

FOLIAGE—The yellow-green to light green needles are borne in bundles of two and are 1 to 3½ inches long.

CONES—The cones are 1 to 2 inches long, rather woody with small prickles on the tip of the cone scales. The cones are borne close to the branches and point back along the stem. They remain attached to the tree for many years. Often, especially in southern Idaho, the cones remain closed until after heat from a fire has caused them to open.

BARKED LOGS—On the outer surface lodgepole pine logs often have a dimpled appearance. Ends of logs show pitch exudation from the sapwood.

Figure 21.
Western Hemlock

Figure 22.
Lodgepole Pine

11. WHITEBARK PINE (*Pinus albicaulis*).

BARK—On young trees the bark is smooth, thin, and grayish or purplish with small resin blisters. Mature trees have bark which is broken into narrow brown to almost silvery, plate-like scales. The barks of limber pine and whitebark pine are very similar. The barks of whitebark pine and lodgepole pine in southern Idaho are also quite similar.

FOLIAGE—The needles, borne in bundles of five, 1½ to 2½ inches long, are stout, rigid, and dark green (similar to limber and western white pine—see remarks under limber pine). Whitebark pine is found throughout the high mountain areas of the State and may be confused with either western white or limber pine.

CONES—The cones are the only reliable method of discriminating between whitebark pine and limber pine. Whitebark pine cones are 1½ to 3 inches long, rounded, purple-brown in color, with no prickles on the tips of the cone scales. The cone scales do not open at maturity; they remain closed until the cone rots.

12. BLACK COTTONWOOD (*Populus trichocarpa*). Also called cottonwood, poplar, northern black cottonwood, and Balm-of-Gilead.

BARK—On young trees the bark is smooth, gray-brown, and broken by dark, vertical and horizontal streaks and cracks. It becomes deeply furrowed and almost black to silvery gray on very large trees. This is the largest broadleaf tree in Idaho. Diameters over 3 feet and heights over 150 feet are not uncommon in the larger river valleys of northern Idaho.

SAPWOOD—The sapwood is pale brown or whitish and is not clearly defined.

HEARTWOOD—The heartwood, gray-white to pale brown or sometimes almost white, is not clearly differentiated from the sapwood.

FOLIAGE—The leaves are 5 to 6 inches long, 3 to 4 inches wide, broadly rounded on the lower part and tapered to a sharp point at the tip; the leaf stems are long and rounded. The buds are pitchy.

FRUIT—The fruit is similar to that of quaking aspen except that the clusters are larger and longer.

Figure 23.—Whitebark Pine.

Figure 24.—Black Cottonwood.

13. PAPER BIRCH (*Betula papyrifera*). Also called white birch.

BARK—The bark is usually a smooth, chalky white on all but the youngest trees. It peels off in papery layers and is marked by long, thin, dark horizontal streaks.

SAPWOOD—The sapwood is usually cream-colored or sometimes almost white to pale brown.

HEARTWOOD—The heartwood is very light brown to medium brown and is often not markedly different in color from the sapwood.

FOLIAGE—The leaves are somewhat rounded in outline, 2 to 4 inches long, but narrower and thinner than quaking aspen. The leaf margins have irregular sharp-angled teeth, and the leaf stem is rounded.

FRUIT—The small cone-like fruits are composed of very small papery scales and seeds; in the fall these dry and gradually fall apart, liberating the seeds.

Figure 25.—Paper Birch.

14. LIMBER PINE (*Pinus flexilis*).

BARK—On young trees the bark is smooth and greenish or grayish in color; small resin blisters are often present. On mature trees the bark is dark brown, shallowly furrowed, and divided into more or less rectangular plates. Since limber pine is often a high mountain species, exposure may cause the bark to remain relatively thin and silvery in color.

FOLIAGE—The needles, borne in bundles of five, are 1½ to 3 inches long and are stout, rigid, and dark green in color. They are very similar to the needles of whitebark pine, and the foliage of the two species cannot be readily differentiated. The needles are also similar to the needles of western white pine, except that they are stouter, shorter, and darker green in color. Limber pine has not been reported north of the Lochsa River drainage in northern Idaho; hence it is rarely found growing near western white pine.

15. MOUNTAIN HEMLOCK (*Tsuga mertensiana*). Also called black hemlock or alpine hemlock.

BARK—The bark, very similar to the bark of the western hemlock, becomes scaly at an early age. This is a high mountain species and is rarely found in the same locality as western hemlock.

FOLIAGE—The needles are semi-circular in cross sections, ½ inch to 1 inch long, and pale blue-green on both surfaces; the foliage is very dense and gives the tree a dark appearance, hence the name black hemlock.

CONES—The cones are cylindrical, about 1 to 2 inches long, and dark brown to purple-brown. After opening, the cones may hang on the tree for a year or more; such cones often have scales which are bent backward toward the base.

16. JUNIPERS. Also called cedar. In Idaho there are four species of juniper which reach tree size. These are Rocky Mountain Juniper (*Juniperus scopulorum*), western juniper (*Juniperus occidentalis*), Utah juniper (*Juniperus osteosperma*), and one-seed juniper (*Juniperus monosperma*). The last three of these are restricted to the southern one-third of the state. The identifying characteristics given below are for all Idaho junipers and will not serve to separate the different junipers.

BARK—The bark is fibrous and thin. On young trees it is often bright reddish-brown, gradually becoming darker brown as the tree matures; older trees often have a gray-brown bark. Flat, narrow ridges develop in older bark, but the fibrous character remains.

SAPWOOD—The sapwood is cream-colored to almost white and contrasts sharply with the darker heartwood. Irregular streaks of sapwood are often included in the heartwood of this species.

HEARTWOOD—Depending on the species of juniper, the heartwood ranges from a bright reddish-brown through dull red-brown to light and dark brown.

FOLIAGE—The foliage on larger trees is "cedar-like" and consists of small, scale-like, overlapping leaves. Color depends somewhat on the species; it varies from light gray-green through light and dark green to a definite yellow-green.

FRUITS—The fruits are small berries, ranging from copper color through dark reddish-blue to almost black. They are often covered with a thin, white, waxy coating. Under the outer fleshy layer, there are from one to three seeds.

17. QUAKING ASPEN (*Populus tremuloides*). Also called quaking asp, aspen, quaker or trembling aspen.

BARK—On all but very old trees over 12 inches in diameter breast high (d.b.h.), the bark is smooth, greenish-white to cream-colored, and broken by dark, irregular horizontal streaks of rough bark. On older trees, the bark at the base becomes deeply furrowed and almost black in color.

SAPWOOD—The sapwood, whitish or cream-colored, gradually merges into the heartwood and is not clearly defined.

HEARTWOOD—The heartwood is soft, whitish to very pale brown, and has a disagreeable odor when wet. The heartwood is not clearly distinct from the sapwood.

FOLIAGE—The leaves are broad and flat, 1½ to 3 inches in diameter, and heart-shaped in outline. The leaf stem is flattened at right angles to the leaf blade, and the leaf margin has rounded teeth.

FRUIT—The fruit consists of small capsules in dense, drooping clusters; in late spring, the capsules mature and liberate tiny seeds which are carried on white, cottony tufts.

18. THINLEAF ALDER (*Alnus tenuifolia*). Also called alder.

BARK—The bark is thin and gray-brown to pale gray in color; the smooth surface is broken by irregular groups of wart-like bumps. On large trees (over 12 inches d.b.h.) the bark becomes furrowed and is brown to red-brown in color.

SAPWOOD—The sapwood is difficult to distinguish from the heartwood; it is light cream or flesh-colored when first cut, but rapidly turns a bright rust red on exposure to the air.

HEARTWOOD—The heartwood is light brown to pale reddish-brown and is not easily differentiated from the sapwood. The heartwood does not react in the same manner as the sapwood when freshly cut.

FOLIAGE—The leaves are 3 to 6 inches long, oval in outline with an irregular, deeply-toothed margin and a pointed tip.

FRUIT—The seeds are very small and are borne in conspicuous "cone-like" fruits, which can usually be found on the tree at all times of the year. The cones are rounded and about ½ inch long. The cone scales are persistent.

V LOG DEFECTS AND DETERMINATION OF DEDUCTIONS

Although the scaling of logs is based on straight and sound logs, nature seldom grows a perfect tree. If all logs were straight, smooth, round, and sound, the operation of scaling would be purely mechanical. Because they are not, it is necessary for the scaler to know how to determine the amount of loss or unsound material resulting from various defects.

Taking into consideration the limits of merchantability specified by timber sale contract or by employer's instructions, a defect may be rot, or any other loss or missing material caused by crooks, checks, shake, pitch ring, cat face, or other irregularities that actually reduce the amount of sound usable material within the slabbed area of the scaling cylinder.

It is important to note that a condition which may be considered a defect in the grading of lumber is not necessarily considered a defect in scaling a log. Scaling is concerned with the quantity of sound lumber that may be produced from a log; grading is concerned with the quality produced.

In making deductions for defects, the scaler should bear in mind the following:

1. No deduction is made for discoloration or firm stain; however, such discoloration or stain may indicate deductible defect in a log.
2. No deduction is made for defect outside the slabbed area of the scaling cylinder.
3. No deduction is made for defect that does not actually reduce the amount of sound material that may be produced in accordance with the established limits of merchantability.

GENERAL METHODS OF DEDUCTION

Interior defects are comı 'o almost all species. In some instances, the defect will extend through tl tire length of the log. This is especially true of shake and pitch ring and ..rtain rots. In the absence of other instructions arising from timber sales contracts, merchantable lumber lengths, or some similar reason, the larger diameter of defects occurring in logs, 14 feet and shorter, is generally used in making calculations for deductions. The average diameter of the defect is considered to be correct for single logs, 16, 18, and 20 feet in length.

To determine the diameter of the defect in the center of logs longer than one scaling length, the average of the dimensions of the defect on both ends of the double-length log should be used.

By close inspection of the log for seams, conks, scars, abnormal swellings, or other visible indications, the scaler should determine the length of the defect. He should be guided by his judgment and by local defect characteristics in making this length determination.

If the defect is so close to either end of the log that the sound material from that point to the end is below the minimum length for merchantable lumber, the length of the defect is carried to the end of the log.

STANDARD RULE. The most common method of mathematically reducing the scale for interior defects showing in one or both ends of the log is to treat the defects as sawed-out squares or rectangles. In applying the standard rule, the actual end dimensions of the square or rectangle which bound the defect are taken and the length of the defect is determined. One inch is added to the actual height and width of the square or rectangle to compensate for additional sound material which will be lost in sawing out the defect.

The Scribner decimal C rule is based upon diagrams of 1-inch boards with ¼-inch saw-kerf. The rule makes allowances for the 20 per cent of any square or rectangle inside the slabbed surfaces of the log that is lost by saw-kerf.

The substance of the standard rule is to deduct 80 per cent of the board-foot contents of a piece of timber having the same dimensions as the defect. The entire process may be stated algebraically as follows: If W″ and H″ represent the end dimensions of the defect in inches, L′, the length of the defect in feet, and X the deduction in board feet after 20 per cent is deducted for kerf:

$$X = \frac{W'' \times H'' \times L'}{12} \times \frac{80}{100} = \frac{W'' \times H'' \times L'}{15}$$

X must then be raised or lowered to the nearest 10.

An example of the standard rule in practice follows: The top diameter of a 16-foot log is 21 inches, making the gross volume of the log 300 board feet. In the butt of the log is a spot of heart rot whose end dimensions are 5 inches square. The rot is estimated to go into the log 4 feet. Stated in terms of the formula above:

$$\frac{6 \times 6 \times 4}{15} = \frac{144}{15} = 9.6 \text{ board feet}$$

(6×6×4: The heart rot measured 5 inches square. Adding the 1 inch allowance for sound material surrounding the defect, 6 inches is used in figuring the deduction. The 4 feet represents the estimated number of feet the rot extends into the length of the log.)

Rounded to the nearest 10, the amount deductible for defect is 10 board feet. Subtracted from the gross scale of 300, the result is 290 board feet. The 290 is recorded as the net scale.

SQUARED DEFECT METHOD. In this method, which is a simplification of the standard rule, the height of the defect plus 1 inch is multiplied by the width of the defect plus 1 inch, and the result raised to the *next higher* 10. This figure actually represents the amount of deduction that would be made for the defect if it extended the full length of a 16-foot log. If the defect extends for only a portion of the 16-foot length, the result is multiplied by the ratio of the length of the defect to a 16-foot log. The result of this last calculation is then brought to the *nearest* 10. The calculations noted above will give very accurate results for defects up to and including 12″ x 12″. If the defect exceeds 12″ x 12″, an additional 10 board feet should be added to the deduction. The formula for the squared defect method is as follows:

$$D = W \times H \text{ to next higher } 10 \times \frac{LD}{16} \text{ to nearest } 10$$

W=width of defect plus 1 inch
H=height of defect plus 1 inch
LD=length of defect in feet
D=board foot deduction

Thus, employing the same example as used for the standard rule method:

$$6 \times 6 = 36 \text{ to the next higher } 10 = 40$$

$$40 \times \frac{4 \text{ (length of defect)}}{16 \text{ (16′ log)}} = 10 \text{ board feet}$$

It is important to remember that the actual length of the log being scaled is not considered in computing this formula. The formula is based upon a constant of 16 feet.

KNOUF'S RULE OF THUMB. Knouf's rule differs from the standard rule in that 1 inch is not added for loss of sound material. To work this rule, obtain the average diameter of the defect; add to this diameter:

½ of the diameter of the defect if it is 9 inches or less.

⅓ of the diameter of the defect if it is 10 to 19 inches, inclusive.

¼ of the diameter of the defect if it is over 19 inches.

Figure the scale of a log of this extended diameter and the length of the log in question and deduct the result from the gross scale.

Using the same example as under the standard rule and the squared defect method: The diameter of the defect is 6 inches, to which is added one-half of the diameter because the diameter is less than 9 inches, making the extended diameter 9 inches. A 16-foot log with a 9-inch diameter will scale 40 board feet. The defect is 4 feet in length, and this 4 feet represents one-fourth of the total log length; one-fourth of 40 is 10 board feet to be deducted from the gross scale.

SEGMENT SCALING. Mentally divide the log into two or more segments, whichever is necessary to place the defect into one segment of the log. Then deduct a portion of the segment by one-half or a third, or whatever is necessary to allow for the defect. This rule is especially helpful in figuring deductions for fire scars, lightning defects, and similar deductions.

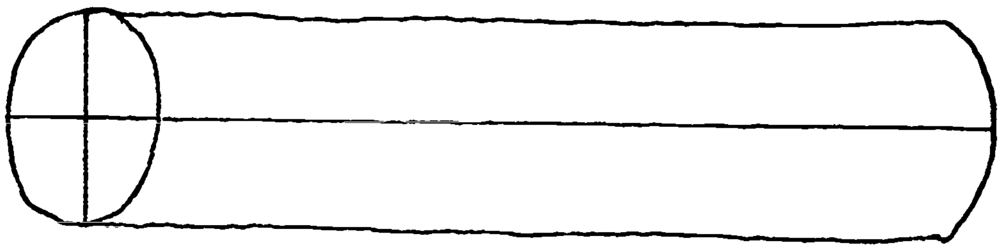


Figure 26.—Log divided into segments.

LENGTH CUTS. It is practical to make length cuts when the deduction for squared defect for the length affected exceeds the scale for the log length involved. For example: In a 16-foot log, 16 inches in diameter, scaling 160 board feet, with rot 12 inches in diameter affecting 4 feet of the log, the squared defect deduction would be 50 board feet. As this deduction exceeds a 4-foot length cut, or 40 board feet, a length cut should be used.

ROUGH CUTS. In present utilization of material in extremely rough and limby tops, diameter deductions should be allowed where there is a definite loss of volume because of large dry knots over 4 inches in diameter with less than 2-foot average spacing between them, knot clusters, and roughness. *Suggested guides* for diameter cuts are as follows:

Logs 15 inches and less in diameter	1-inch deduction
Logs 16 to 25 inches in diameter	2-inch deduction
Logs 26 to 35 inches in diameter	3-inch deduction
Logs 36 to 45 inches in diameter	4-inch deduction
Logs 46 inches and over in diameter	scaler's judgment

The diameter deductions given above are suggested as guides; a scaler may raise or lower the deductions according to the roughness of the individual log. Types of logs affected are fringe-type Douglas fir and white fir with large dry limbs, larch with large knot clusters, and ponderosa pine with numerous sucker limbs and indentations in the log caused by large limbs. All of these conditions cause losses in volume recovery.

SPIRAL CHECK, LIGHTNING SCAR, OR PITCH SEAM. When checks, lightning scars, or pitch seams spiral or turn in a log, calculate the deduction by the squared defect method. If the check or seam turns or spirals 45 degrees or less from one end of the log to the other, add 50 per cent to the deduction. If the check or seam turns or spirals 46 to 90 degrees, double the deduction.

ROTTEN OR HOLLOW KNOTS. *If the log does not show end indications of rot,* reduce the diameter of the log 1 inch for each face affected by rotten or hollow knots which are not associated with white pocket rot, ring rot, etc., provided that no other deduction includes these same rotten or hollow knots.

LOG DEFECTS

Generally speaking, the defects in logs with which the scaler is concerned will fall into three major classifications: Defects due to fungi, defects due to other natural causes, and defects due to logging operations.

OTHER NATURAL DEFECTS

MECHANICAL DEFECTS

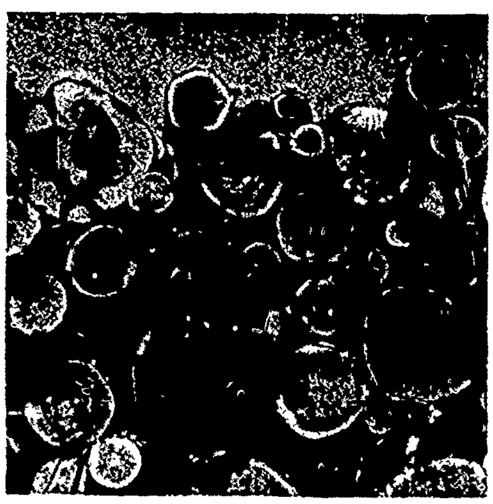


Figure 27.—Typical log defects.

FUNGOUS DEFECTS

Most of the volume loss which is deducted in scaling is caused by the feeding activities of fungi and resulting decay. The fungi organisms consist of microscopic filaments that are able to penetrate, to break down and to use the wood cells for food. After this feeding activity and the resulting decay of wood have progressed far enough, reproductive structures, commonly known as "conks," develop on the decaying wood. In both scaling and cruising, these conks are helpful as indicators of decay; but the scaler usually recognizes the presence of rot by its appearance on the end of a log. Sometimes conks remain on logs, but generally they are dislodged before the log reaches the landing or log deck where the scaler is operating.

For the most part, the rots of living trees are confined to the heartwood and dead sapwood around wounds. Most wood decay fungi do not invade living sapwood. On dead trees and logs and smaller material, the reverse is true. The sapwood deteriorates rather rapidly, whereas the heartwood is usually considerably more resistant to decay. Many decay fungi affect heartwood of living trees as well as the sapwood and heartwood of dead material. Some are important only as heart rot fungi, and others are known to cause decay in dead material only. On this basis, rots can be classified as heart rots and sap rots.

Many of the heart rot fungi are found only in the roots and the butt of the tree. These fungi generally enter the tree through the roots or through basal injuries, such as fire scars, where dead sapwood is continuous with heartwood. Because it is the valuable butt log that is affected, the actual financial loss is greater in proportion to volume loss than when the rot occurs higher in the tree. Other decay fungi are usually found in the upper or middle trunk. These fungi enter the tree through branch stubs, broken tops, or other injuries. Because of this localization in the tree, rots are frequently referred to as trunk rots or butt rots, and are so arranged in this manual. The term "root rot" is also commonly used for the rots which gain entrance to the tree through the roots. These rots are particularly damaging because they usually predispose the tree to windthrow. Some root rots actually kill the living sapwood of roots and directly cause death of the tree.

The color and consistency of the decayed wood also serve as a basis for classifying th rots into two groups, white rots and brown rots. Most of the brown rot fungi feed almost exclusively on the cellulose in the wood and leave behind a brown, crumbly mass, usually made up of more or less cubical chunks. A few of the brown rot fungi break the wood down into a brownish, stringy or laminated residue.

The white rot fungi feed on all components of the wood, and the resulting rots are more varied in appearance than the brown rots. Some have the decay localized in relatively small pockets in the wood, giving it a pitted or honeycombed appearance. Sometimes the pockets of decay may be separated by firm, apparently sound wood. Other white rot fungi break the wood down into a uniform white, mottled, spongy, or stringy residue.

Early stages of decay can often be recognized by definite discolorations of the wood before there is any noticeable change in its other properties. In the case of the white rots, the strength properties of the wood may not be seriously affected in this early stage of decay. In the early stage of the brown rots, however, the wood may have suffered a serious decrease in strength properties, even though there is little or no evidence of change to the naked eye.

The exact number of wood-rotting fungi in Idaho is not known, but an estimate of 1000 species would be quite conservative. Most of the rot that is encountered by the scaler, however, is caused by a very small number of fungi. In this manual, twenty rots have been selected as the ones of major importance in Idaho. Most of these are heart rots of living trees, but a few

2

of the common and rapidly developing sap rots of dead trees and logs have also been included.

On the following pages will be found sketches, diagrams, and suggested methods of deducting for defects due to various fungi and accompanying rots. *However, the scaler must bear in mind that no hard and fast rule can be consistently applied, inasmuch as the extent of damage to individual trees will vary with the age of the tree, the length of time that the fungus has been active in the tree, and the region in which the tree grew.* It cannot be over-emphasized that the scaler, regardless of species being scaled or defect being considered, must consistently scale each log upon its own individual merits. A prime requisite for any scaler is good judgment based upon experience and the observation of defective logs opened up in the sawmill.

A. TRUNK ROTS

1. RED RING ROT—Caused by *Fomes pini* (also called *Trametes pini* in older literature). This rot is also called conk rot, red rot, ring scale, red heart, pecky rot, honeycomb rot, and white pocket rot.

SPECIES AFFECTED—All Idaho conifers except junipers and Pacific yew. Of particular importance in western white pine, ponderosa pine, lodgepole pine, western larch, Douglas fir, and Engelmann spruce.

ROT DESCRIPTION—Red ring rot is primarily a heart rot of living trees. Decay may continue in dead standing trees or in fallen trees, but it is not an important factor in the decay of slash. The fungus usually enters the tree through branch stubs and causes a trunk rot, but it occisionally enters through basal scars and causes a butt rot. In the early stages of decay the wood shows a pinkish to purplish-red discoloration. As decay progresses, small, white, lens-shaped pockets develop parallel to the grain. The wood between these pockets is discolored but firm. On ends of logs the discoloration and pockets are often localized in crescent-shaped areas or in more or less concentric rings. Frequently, however, the pockets are uniformly scattered throughout the decaying wood with no definite pattern of arrangement. A pronounced ring shake may develop as a result of the rapid deterioration of the springwood and the separation of the wood along the annual rings.

INDICATORS OF DECAY—The brownish, perennial conks of *Fomes pini* usually develop at branch stubs or on basal scars. They vary from thin and

Figure 28.
Fomes pini in white pine.

Figure 29.
Fomes pini in ponderosa pine.

bracket-shaped to thick and hoof-like. The undersurface and margin of growing conks is a bright yellowish-brown with large irregular pores, and the upper surface is dark brown to blackish with concentric zones and furrows. Interior tissue of the conks is yellowish-brown and firm. Older conks may be from several inches to as much as 1 foot in diameter, but they generally fall before reaching that size.

Brown punky knots usually indicate decay in the heartwood. The location of punky knots may be indicated by conspicuous swellings commonly called "swollen knots." Where punky knots have healed over with no conspicuous swelling, they are revealed by chopping through the bark into the knot.

EXTENT OF DECAY—It is estimated that from the conk or punky knot (hereafter referred to as a "punk") the rot will extend 3 to 5 feet toward the top and 5 to 7 feet toward the butt of the log. This rot is usually confined to the heartwood of all resinous species. In white pine logs the defect associated with a single punk is generally confined to one-half the diameter of the scaling

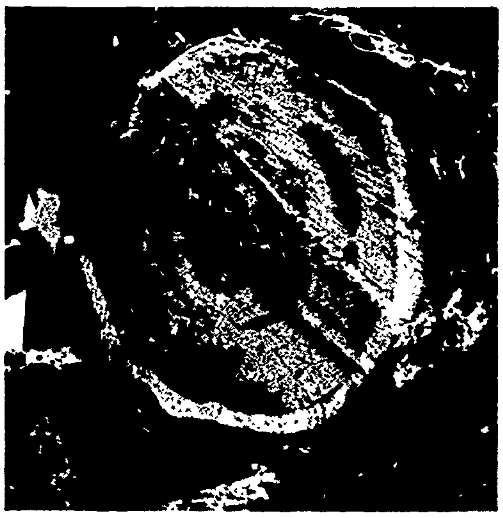


Figure 30.
Fomes pini in Douglas fir.

Figure 31.
Fomes pini in larch.

Figure 32.—Fomes pini in spruce.

cylinder; while in ponderosa pine and other associated species, the defect extends through the entire diameter of the heartwood. As previously mentioned, no hard and fast rule can be consistently applied, inasmuch as the extent of decay on individual trees will vary with the age of the tree and the length of time that the fungus has been active in the tree. It is important that the scaler, regardless of species being scaled, consistently scale each log upon its own individual merits.

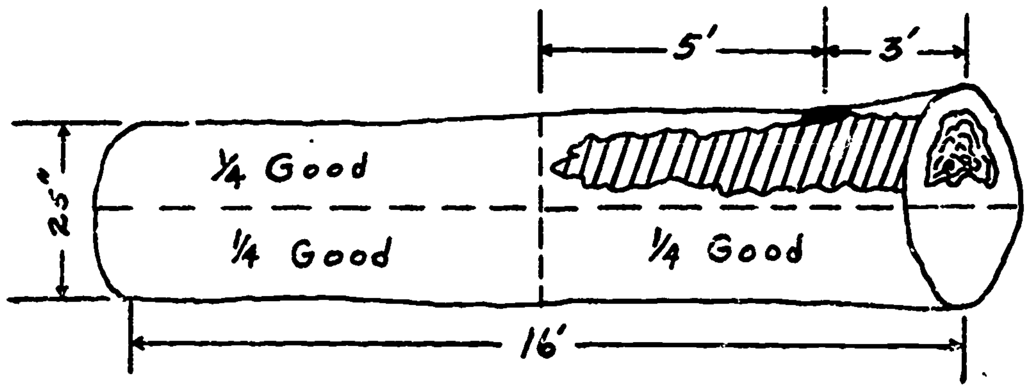


Figure 33.—Old g.owth white pine with a single Fomes pini punk.

In Figure 33, the *Fomes pini* punk is located 3 feet from the butt. In old growth, the defect is calculated to extend 5 feet upward from the punk. This figure clearly shows that half of an 8-foot section of the log should be deducted. This process is simplified by apply.ng the segment rule which will result in a deduction of one-fourth the volume of the log. A sound 16-foot log, 25 inches in diameter, scales 460 board feet; therefore, the log shown would be given a scale of three-fourths of 460, or 340 board feet.

If the punk were found in young second-growth white pine timber, the defect would be figured as extending 3 feet above the punk so that 6 feet of a half-section of the log would be deducted. Because a sound 16-foot log, 16 inches in diameter, scales 160 board feet, the log shown would be given the scale of a 13-foot log or 130 board feet.

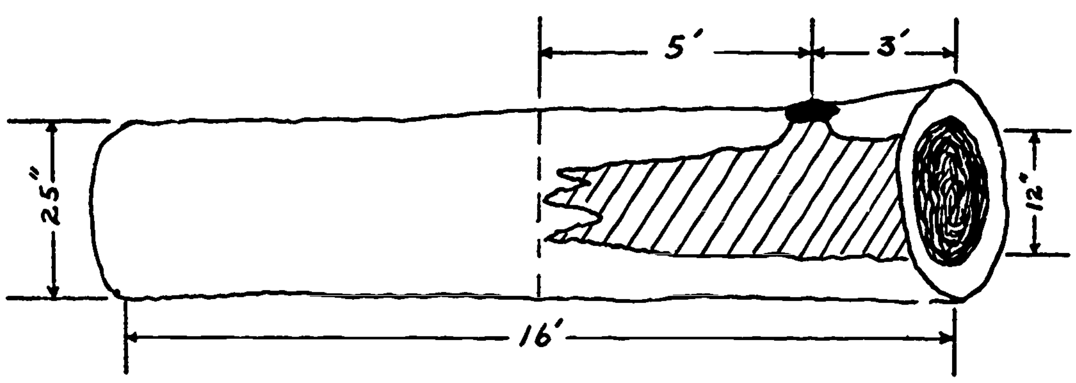


Figure 34.—Ponderosa pine with a single Fomes pini punk.

In Figure 34, a *Fomes pini* punk is located 3 feet from the butt, the same as on the white pine example, Figure 33. In this example you will notice that the full diameter of the log is lost, except for the sapwood which may be as much as 12 inches thick, depending upon the age of the tree and the locality in which the tree grew. This is typical of the effects of *Fomes pini* on Ponderosa pine and other species, excepting white pine.

The ponderosa pine log in Figure 34 would be scaled with a length cut deduction unless the sound sapwood, which falls outside the squared-out defect exceeds 33⅓ per cent of the gross volume of the log; in which case, the scaler would make deduction by Knouf's rule of thumb or by the squared defect method of deduction, plus allowance for the rotten knot associated with the defect. Even though a great percentage of the gross volume of the log lies in the few inches of the outer shell, the scaler should bear in mind that the defect must be squared-out, thus changing the per cent of merchantable lumber in the outside shell. Figures 35 and 36 are examples of this.

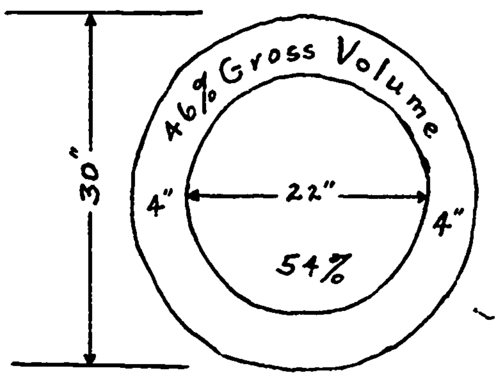


Figure 35.—Per cent of gross volume in outer shell.

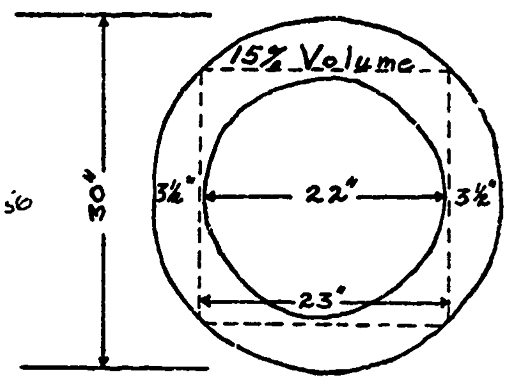


Figure 36.—Per cent of gross volume outside squared defect.

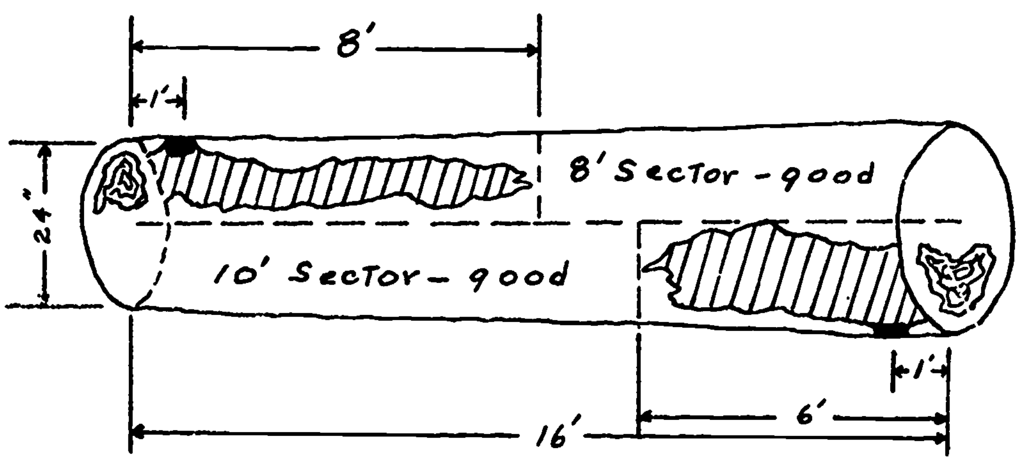


Figure 37.—Old growth white pine log with two Fomes pini punks.

Figure 37 shows a 16-foot white pine log (old growth) containing two *Fomes pini* punks: One on the upper side 1 foot from the top end of the log, the other one on the lower side 1 foot from the butt end of the log. It is estimated the rot will extend 3 to 5 feet from the punk toward the top and 5 to 7 feet toward the butt of the log. This figure clearly indicates that the punk and associated rot on the top end of the log will cull half of the upper 8 feet of the log. The punk on the bottom end will cull half of a 6-foot section of the log. By applying the segment scale, the log will be given the full scale of a 9-foot log or one-half the scale of an 18-foot log. In a second-growth log the length of the defect would be 3 feet upward from the punk and 5 feet downward.

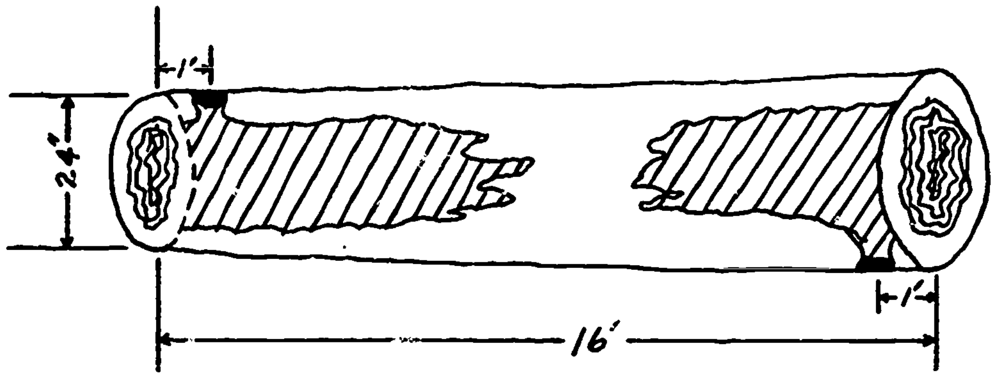


Figure 38.—Ponderosa pine log with two Fomes pini punks.

Figure 38 shows a 16-foot ponderosa pine log containing two *Fomes pini* punks: One on the top side 1 foot from the top end of the log, the other on the bottom side 1 foot from the butt end of the log, the same as shown in the white pine example, Figure 37. You will note that each punk and the associated rot affects the full diameter of the log, except for the sapwood. This is typical of the effects of *Fomes pini* on ponderosa pine and other species, excepting white pine. The above ponderosa pine log would be culled unless the sound sapwood which falls outside the squared-out defect exceeds 33⅓ per cent of the gross volume of the log; in which case, the scaler would make deduction by Knouf's rule of thumb or by the squared defect method of deduction, plus allowance for the two rotten knots associated with the defect.

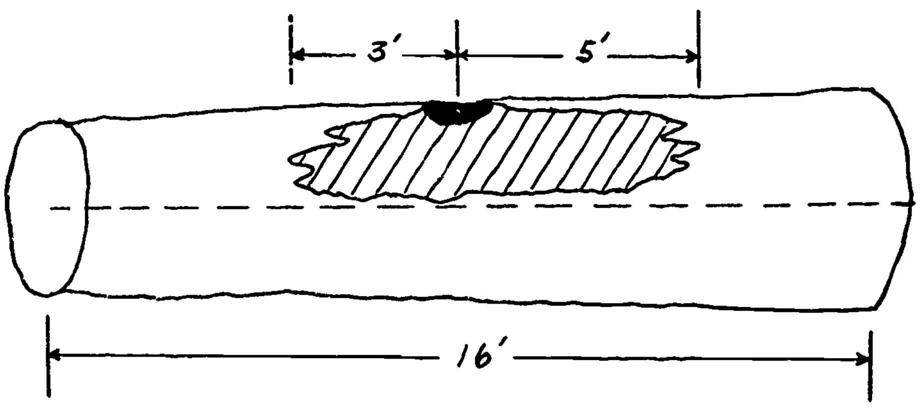


Figure 39.—Fomes pini punk in second-growth white pine log.

The location of the punk in Figure 39 shows it to be directly in the center of a 16-foot white pine second-growth log. Inasmuch as the log is second growth, the rot will extend upward 3 feet from the punk, leaving only 5 feet of sound wood in this end of the upper half of the scaling cylinder. The rot also extends 5 feet downward from the punk, thus leaving only 3 feet of sound wood in the other end of the top half of the scaling cylinder. Lumber lengths under 6 feet are considered unmerchantable in white pine; therefore the entire upper half of the scaling cylinder would be culled. The scale of such a white pine log would be one-half the full scale. In old growth white pine the defect as shown would extend upward 5 feet from the punk and downward 7 feet from the punk and would affect only one-half the scaling cylinder.

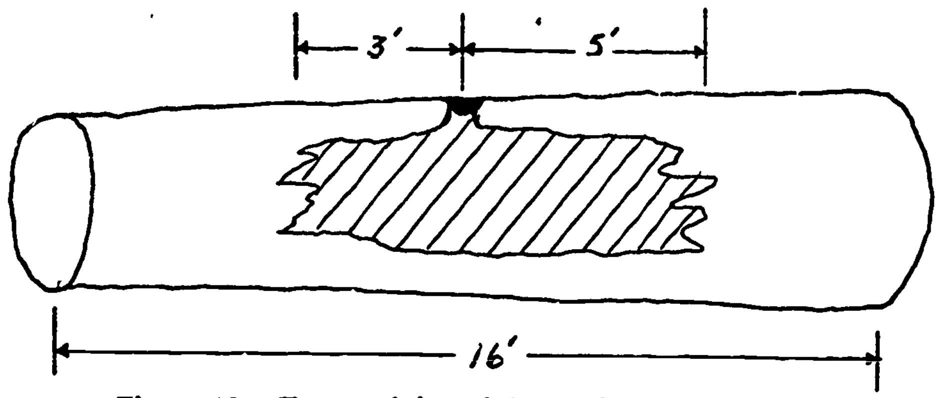


Figure 40.—Fomes pini punk in ponderosa pine log.

Figure 40 shows a *Fomes pini* punk located directly in the center of a 16-foot ponderosa pine log. You will note that the full diameter of the log is affected, except for the sapwood. This is typical of *Fomes pini* in ponderosa pine and other species, excepting white pine. A reddish-brown or purplish stain on the ends of the log may give the scaler an indication of the severity of the defect; or sounding with a scaler's hatchet may also be helpful in determining the extent of decay. The ponderosa pine log in Figure 40 would be culled unless the sound sapwood which falls outside the squared-out defect exceeds 33⅓ per cent of the gross volume of the log; in which case, the scaler would make deduction by Knouf's rule of thumb or by the squared defect method of deduction, plus allowance for the rotten knot associated with the defect.

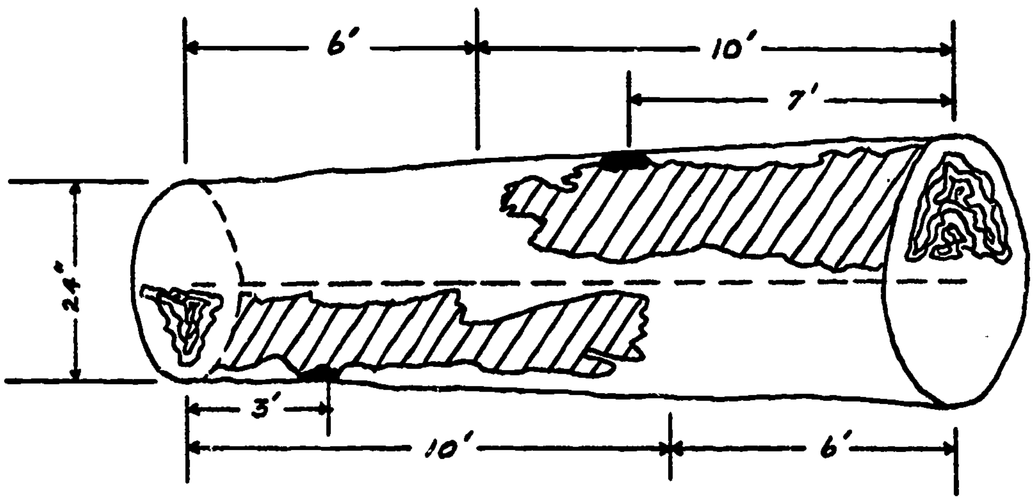


Figure 41.—Fomes pini punks in a white pine log.

In Figure 41, one punk is located 7 feet from the butt on the side of a 16-foot white pine log; the other punk is 3 feet from the top on the opposite end of the log, leaving 6 feet of merchantable lumber on each side. By applying the segment scale, it will be found the log has a volume of a 6-foot merchantable log or one-half the volume of a 12-foot log. A 16-foot log with a 24-inch diameter scales 400 board feet; a 6-foot section scales 150 board feet, which is the net scale of the log shown in Figure 41.

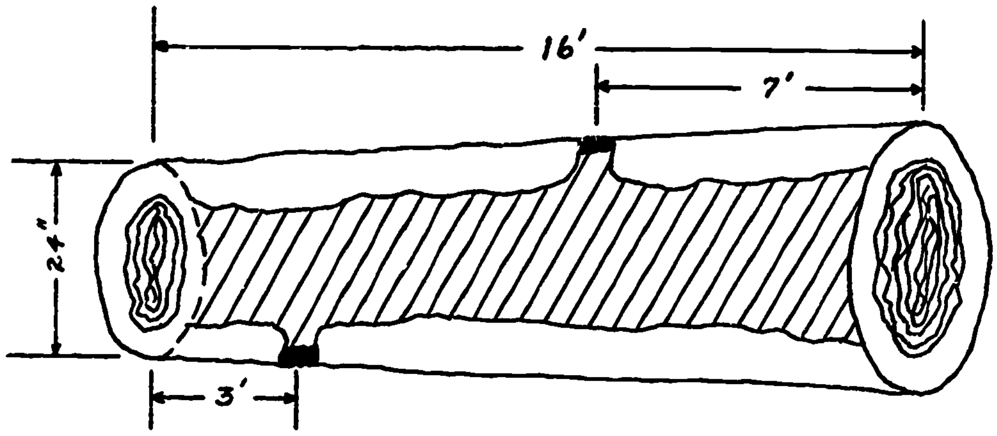


Figure 42.—Fomes pini punks in a ponderosa pine log.

In Figure 42, one punk is located 7 feet from the butt on one side of a 16-foot ponderosa pine log. The other punk is 3 feet from the top on the opposite side of the log. You will note that the full diameter of the log is affected, except for the sapwood. This is typical of *Fomes pini* in ponderosa pine and other species, excepting white pine. The entire log would be culled unless the sound sapwood which falls outside the squared-out defect exceeds 33⅓ per cent of the gross volume of the log; in which case, the scaler would make deduction by Knouf's rule of thumb or by the squared defect method of deduction, plus allowance for the rotten knot.

2. RED RAY ROT—Caused by *Polyporus anceps*. This rot is also known as western red rot.

SPECIES AFFECTED—A heart rot in ponderosa pine, also a slash rot in that species as well as in Douglas fir, grand fir, Engelmann spruce, western white pine, western redcedar, and lodgepole pine.

ROT DESCRIPTION—Red ray rot is common in living ponderosa pine, entering mainly through broken tops and dead branches and causing a trunk rot in that species. It also causes a common slash rot of ponderosa pine and the other conifers listed. In the early stages of decay the wood develops a reddish-brown discoloration. Later, small white pockets of advanced decay develop parallel to the grain. These pockets are usually poorly defined, have blunt or almost square ends, and tend to run together. Usually the wood between the pockets is considerably softer than sound wood; eventually the wood becomes a white spongy mass. In the heartwood, the rot typically develops in distinct radial zones fron the center of the tree; and this distinctive radial pattern on the ends of logs is characteristic of this rot. As decay progresses, however, the entire heartwood may be invaded; and this radial pattern will not be apparent.

INDICATORS OF DECAY—The conks do not ordinarily develop on living trees, but are usually present on stumps, decaying logs, and slash. They are annual, white, crust-like, and bracket-shaped; although rather tough, they usually deteriorate rapidly. On dead material, a conspicuous white mat of fungous tissue develops between the bark and the wood.

EXTENT OF DECAY—The extent of rot columns will vary with the size of the timber and possibly from one locality to another. In advanced stages of decay, the defect affects the entire heartwood; the deduction is made by reducing the length of the log for the estimated distance affected. In earlier stages of decay, the defect appears as a cylinder or hole; and the deduction is made by using the standard rule or Knouf's rule of thumb.

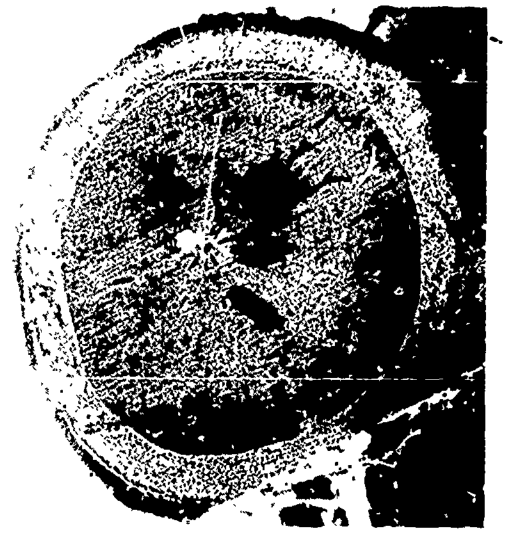


Figure 43.—Early stages of red ray rot in ponderosa pine.

(Photos courtesy of U.S. Forest Service)

Figure 44.—Advanced stages of red ray rot in ponderosa pine.

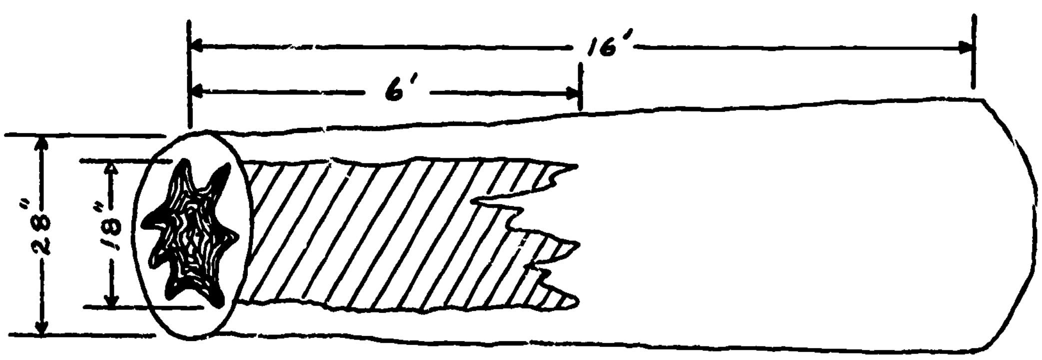


Figure 45.—Polyporus anceps in a 16-foot log.

Polyporus anceps, sometimes called "wagon wheel" decay is a common defect in spike top ponderosa pine. It is not uncommon to find this rot extending as much as 40 feet downward into the trunk of the tree. In Figure 45, the defect is shown to extend downward from the top of the log for a distance of 6 feet.

By using the standard defect method for deduction, proceed as follows:

$18+1=19$

$$\frac{19\times19\times6}{15}=\frac{2166}{15}=144 \text{ to nearest } 10 = 140 \text{ board feet net deduction}$$

A 16-foot log, 28 inches in diameter, has a gross scale of 580 board feet. The net scale of this log would be 580 minus 140, or 440 board feet.

3. BROWN TOP ROT—Caused by *Fomes roseus*.

SPECIES AFFECTED—Douglas fir, grand fir, western larch, Engelmann spruce, western white pine, lodgepole pine, ponderosa pine, juniper, and western redcedar.

ROT DESCRIPTION—Heart rot caused by *Fomes roseus* generally enters the tree through broken tops, localizes in the top of the tree, and is often limited to the unmerchantable top portion. This top rot is most common in Douglas fir. The rot also occurs in stumps, dead trees, and stored logs. A yellowish-brown to dark brown discoloration develops in the early stage of decay. The advanced decay is characterized by the formation of irregular, crumbly, brown cubes. Thin, whitish, or pale, rose-colored fungous tissue sometimes develops in the cracks bewteen the cubes of decayed wood.

INDICATORS OF DECAY—The conks of *Fomes roseus* are perennial, woody, and bracket-like to hoof-shaped. The upper surface is brown to black and is usually cracked and roughened. The undersurface has small circular pores and is rose-colored, as is the inner tissue of the conks. Although old broken tops may indicate the presence of this rot, they are not a specific indication, as tops may also be invaded by other decay fungi.

EXTENT OF DECAY—Brown top rot is usually confined to the top portion of the trunk and, in some cases, may require culling the log. In lodgepole pine, this rot very often goes the full length of the trunk and necessitates culling the entire tree. Because this defect is generally confined to the top portion of the tree and affects the entire heartwood, the method of deduction most commonly used is a length reduction for the part affected. Seldom does the rot extend down the trunk far enough for a cylinder deduction or Knouf's rule to be applied.

4. BROWN TRUNK ROT — Caused by *Fomes officinalis* (sometimes called *Fomes laricis* in older literature). Also known as dry rot or red-brown heart rot.

SPECIES AFFECTED—Western larch, Douglas fir, and ponderosa pine are the most common hosts. It also occurs in western white pine, Engelmann spruce, lodgepole pine, western hemlock, and true firs. Hardwoods are not affected.

ROT DESCRIPTION—This rot is one of the major heart rots of living western conifers and continues its decaying action in logs and stumps. The fungus generally enters the heartwood through broken tops and branch stubs, and the rot is common in the upper and middle portions of the trunk. When basal scars are invaded, decay occurs in the butt of the tree. A yellowish to faint reddish-brown discoloration marks the early stage of decay. As decay progresses, the wood becomes softer and eventually breaks down into a crumbly mass of yellowish-brown to reddish-brown cubical chunks that are interwoven with extensive mats of whitish, resinous fungous tissue. These mats may become ¼ inch thick and cover several square feet. On ends of logs, the early stages of decay appear in roughly circular areas of yellowish-brown to reddish discoloration. In the late stages, these circular areas show extensive radial and concentric shrinkage cracks filled with white mats of fungous tissue.

INDICATORS OF DECAY—Conks of *Fomes officinalis* develop only after extensive decay in the heartwood. They are perennial, hard, and chalky; and, after many years of development, they tend to be long and cylindrical in shape. The tissue is white, chalky, and tastes extremely resinous and bitter. The outer layers of tissue usually become grayish or black and extensively cracked, while the undersurface is white with small pores. Broken tops often indicate the presence of brown trunk rot, although top injuries may be invaded by other decay fungi.

EXTENT OF DECAY—The rot is quite extensive and the presence of a single conk generally indicates the tree is a cull.

Figures 46 and 47.—Brown trunk rot, caused by Fomes officinalis, in western white pine and western larch.

Figures 46 and 47 show *Fomes officinalis,* sometimes called quinine fungous decay, in western larch and white pine. While this fungus is most common as a trunk rot, it sometimes occurs as a butt rot entering fire scars or cat faces.

Methods used to deduct for this defect in advanced stages are to make a length cut deduction; or, when the defect appears as a cylinder or hole, to use the standard rule or squared defect rule.

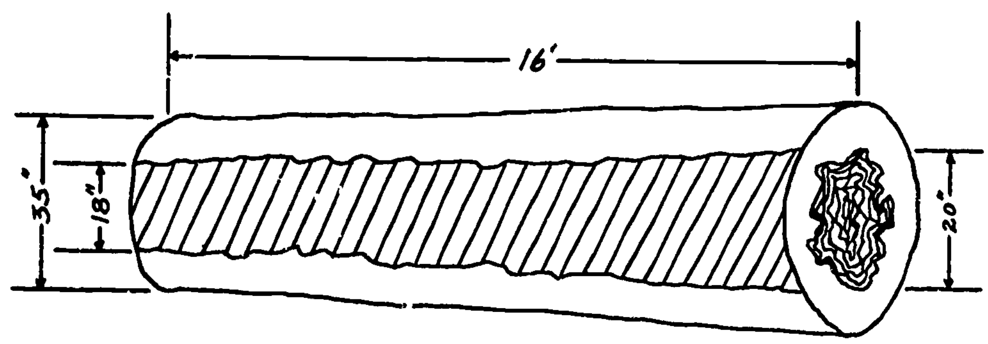


Figure 48.—Fomes officinalis in larch log.

Figure 48 shows a large larch log, the full length affected with *Fomes officinalis* rot. The full scale of the log is 880 board feet. The average diameter of the rot is 19 inches. In using the squared defect method, proceed as follows:

$$19 + 1 = 20$$
$$\times 20 = 400$$
$$400 + 10 = 410 \text{ board feet net deduction}$$

By using the standard rule, proceed as follows:

$$19+1=20$$

$$\frac{20 \times 20 \times 16}{15} = \frac{6400}{15} = 426 \text{ to the nearest } 10 = 430 \text{ board feet net deduction}$$

5. YELLOW PITTED TRUNK ROT — Caused by *Hydnum abietis*. This rot is also known as long pitted trunk rot and long pocket rot.

SPECIES AFFECTED—Western hemlock, grand fir, subalpine fir, and Engelmann spruce.

ROT DESCRIPTION—This rot occurs frequently in the heartwood of living true firs and hemlock and is common in stumps, snags, and fallen trees. It also continues to develop in stored logs. In the early stages of decay, the wood, which remains firm, develops a yellow or pale brownish discoloration and often appears mottled with darker spots. As decay progresses, elongated pockets develop parallel to the grain. These pockets may be empty or may be partially filled with whitish or yellowish fibers of decayed wood. The wood between the pockets is discolored but firm. On the ends of logs, the decay pattern is irregular; in the early stages, it appears as brownish discolored areas, roughly circular in outline. In the advanced stage of decay, the pockets are visible in the discolored areas.

INDICATORS OF DECAY—The white, coral-like, annual conks develop on living trees, stumps, slash, and on ends of recently cut logs. They are soft, extensively branched, and bear large numbers of pendant spines or teeth. Because of their soft, fragile consistency, these conks deteriorate very rapidly and are present as indicators for a relatively short period of time.

EXTENT OF DECAY—Yellow pitted trunk rot is generally confined to the basal portion of the tree. Very little is known regarding the extent of decay by this fungus, but it is included here because of its common occurrence in hemlock and grand fir in northern Idaho. The method usually used for deducting for this defect is the length cut.

6. WHITE TRUNK ROT—Caused by *Fomes igniarius*.

SPECIES AFFECTED—Quaking aspen, paper birch, alders, and other hardwoods. This rot is not found in conifers.

ROT DESCRIPTION—White trunk rot is the most important rot of living hardwoods in Idaho. The rot continues to develop in dead material and is often found on dead and fallen trees and stumps. Pale yellowish discolored areas first appear in the early stages of decay. These discolored areas are commonly enclosed in broad, brownish-black or greenish-brown zones.Narrow black zone lines develop in the decayed wood, which becomes uniformly softer than sound wood. The decayed wood has no pockets or mottling and lacks any stringy or laminated structure. In the advanced stages of decay, abundant yellowish-brown fungous tissue may develop in the decayed wood. The fungus apparently enters mainly through branch stubs, and the rot is usually located in the middle trunk. The rot is often found associated with stem cankers on aspen.

INDICATORS OF DECAY—The conks of *Fomes igniarius* are perennial, hoof-shaped, and hard and woody. The uppersurface is blackish and extensively cracked, and the undersurface is dark brown with very small circular pores. The inner tissue of the conk is dark reddish-brown. On aspen, the conks develop under branch stubs or in the center of stem cankers, when associated with the disease called "black canker of aspen." Out-growths of black, clinker-like structures called "sterile conks" occur frequently at branch stubs. Punky knots are common indicators of white trunk rot and are conspicuous because of the dark brown color of the fungous tissue.

EXTENT OF DECAY—In advanced stages of decay, the center heartwood of the entire log is affected by both *Hydnum abietis* and *Fomes igniarius*; and a length reduction is made. In earlier stages the decay remains firm and colored, and it appears as a cylinder or hole; deduction is then made by the standard rule or Knouf's rule of thumb.

Figure 49.—Fomes igniarius in black cottonwood.

7. STRINGY BROWN ROT — Caused by *Echinodontium tinctorium*. This rot is also called Indian paint.

SPECIES AFFECTED—Primarily grand fir and western hemlock. Subalpine fir and mountain hemlock are frequently affected, and Engelmann spruce and Douglas fir are occasional hosts. Stringy brown rot is reported in a few other Idaho conifers, but it is important only in true firs and hemlock. It does not occur in hardwoods.

ROT DESCRIPTION—Stringy brown rot, which is of major importance as a trunk rot of living fir and hemlock, usually enters the tree through branch stubs or frost cracks. Decay of slash is of little importance as the fungus apparently does not invade dead trees and logs. The first visible evidence of decay in the heartwood is a faint yellowish discoloration. In this stage, separation of the wood along the annual rings tends to develop, especially after drying. As decay progresses, the color darkens; a definite ring shake develops; and rusty-red streaks appear in the wood. In the late stages of decay, the wood breaks down into a brownish stringy mass. In larger trees the rot may destroy the entire heartwood of the trunk down to the roots and may extend into the heartwood of larger branches. Infections of long standing may leave portions of the trunk virtually hollow. On ends of logs, the decay is usually seen as a ring, a solid circular core of discolored softened wood, or as a hollow lined with soft, stringy brown wood.

INDICATORS OF DECAY—Conks of *Echinodontium tinctorium* are perennial, woody, and generally develop under branch stubs. The uppersurface becomes blackened and extensively cracked. Coarse cream-colored to grayish spines form the undersurface. The interior tissue of the conk, including the spines, is a distinctive rusty-red in color. Frequently the knots where conks develop show a similar rusty-red discoloration caused by the build-up of fungous tissue in the later stages of decay. These are known as "rusty knots"; and, after the conks have fallen or have been knocked from the tree during logging operations, they provide a reliable indication of decay in the heartwood.

Whenever butt logs show shake and stain, the log should be thoroughly inspected for the fruiting bodies of this rot or rotten knots. Shake and stain are indicators of this defect. Because of the heavy water content of the extreme butts on both white fir and hemlock, the rot does not break down the wood fiber as quickly as it does in the upper portions of the tree.

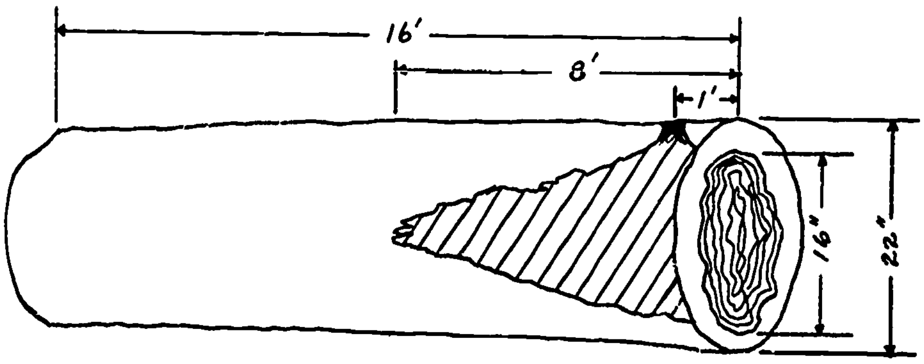


Figure 50.—Indian paint fungus in a white fir or hemlock log.

EXTENT OF DECAY—Figure 50 illustrates a 16-foot white fir or hemlock log that contains an *Echinodontium tinctorium* rusty knot 1 foot from the butt. One rusty knot usually renders the whole cross section of the log worthless for a distance of from 6 to 8 feet or more each way from the punk. By applying the length cut deduction to the above log, the top end will yield 8 feet and should, therefore, be given an 8-foot scale.

If the punk were located 2 or more feet from either end of a 16-foot log, the log would be a cull because lumber shorter than 8 feet is unmerchantable in white fir or hemlock. Two or more rusty knots or conks on a log usually indicate a complete cull.

Figure 51.—Indian paint fungus in hemlock.

Figure 52.—Indian paint fungus in white fir.

B. BUTT ROTS

1. RED-BROWN BUTT ROT—Caused by *Polyporus schweinitzii*. This rot is also called stump rot, cubical butt rot, and brown butt rot.

SPECIES AFFECTED—All Idaho conifers except juniper. Especially common on Engelmann spruce, western white pine, Douglas fir, ponderosa pine, western redcedar, grand fir, western larch, lodgepole pine, and western hemlock. It does not occur on hardwoods.

Rot Description—Red-brown butt rot is important as a root and butt rot of living trees. The rot may continue development in dead trees and stumps, but it is not a major factor in decay of slash. Entrance to the heartwood is most often gained through basal injuries, especially fire scars. The first visible evidence of decay is a pale yellowish or reddish-brown discoloration, usually extending in narrow spires ahead of the advanced decay. A serious weakening of the wood occurs, however, before any visual evidence of decay develops. In the advanced stage, the wood is reduced to a reddish-brown mass that cracks up into cubes and is easily crumbled into powder. A very thin layer of cream-colored fungous tissue often develops in the cracks between the cubes. On end sections of logs, this rot may appear as several isolated pockets of decay or as a single pocket ranging from a few inches to several feet in diameter. The decay can usually be traced to a cat face at the base of the log.

Figure 53.—White pine.

Figure 54.—Ponderosa pine.

Figure 55.—Red fir.

Figures 53 to 55.—Red-brown butt rot, caused by Polyporus schweinitzii. Notice the crumbly cubical nature of the decayed wood.

INDICATORS OF DECAY—The annual conks of *Polyporus schweinitzii* generally develop on the duff around the base of decayed trees, although occasionally they develop on the butt of the tree. On trees they are thin and bracket-like; growing on the ground, they are more or less circular, thin, and stalked. The uppersurface is reddish-brown and velvety or plush-like with concentric zones. The undersurface is olive green on fresh growing conks and dark reddish-brown on dead ones. Basal scars are so generally invaded by this fungus that they are quite reliable indicators of decay. When red-brown butt rot is present in a tree, it is almost always visible on the lower end of the butt log.

EXTENT OF DECAY—This rot generally extends from 2 to 24 feet up the trunk from the butt and is usually confined to the heartwood. Sounding with a scaler's hatchet is often helpful in determining the approximate distance the rot extends into the log.

Polyporus schweinitzii, as previously noted, is quite common to Idaho conifers and, in advanced stages, affects the entire heartwood of the butt of the tree or log, leaving a clear outside shell. Often this type of log is longbutted above the swell of the butt, and deduction is made by the standard rule or Knouf's rule of thumb for cylinder defects.

The log in Figure 56 is 24 inches in diameter at the top end and has a gross scale of 400 board feet. The rot is 12 inches in diameter and is estimated

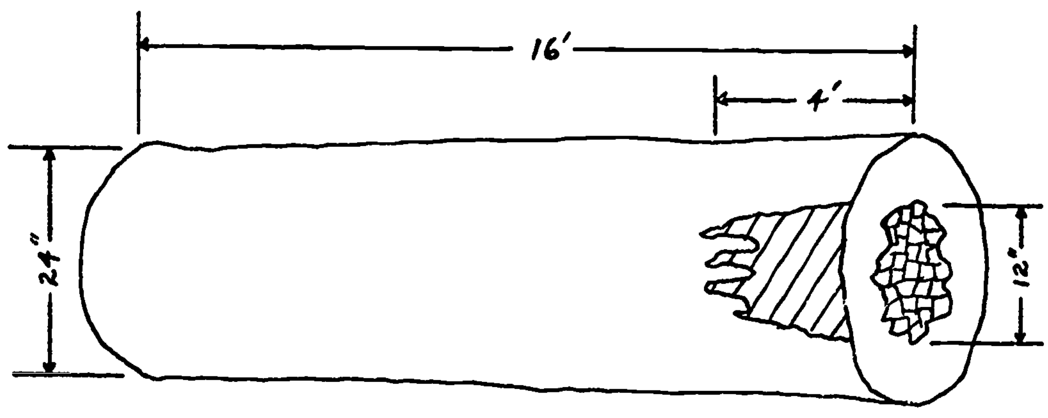


Figure 56.—Red fir log with brown butt rot caused by Polyporus schweinitzii.

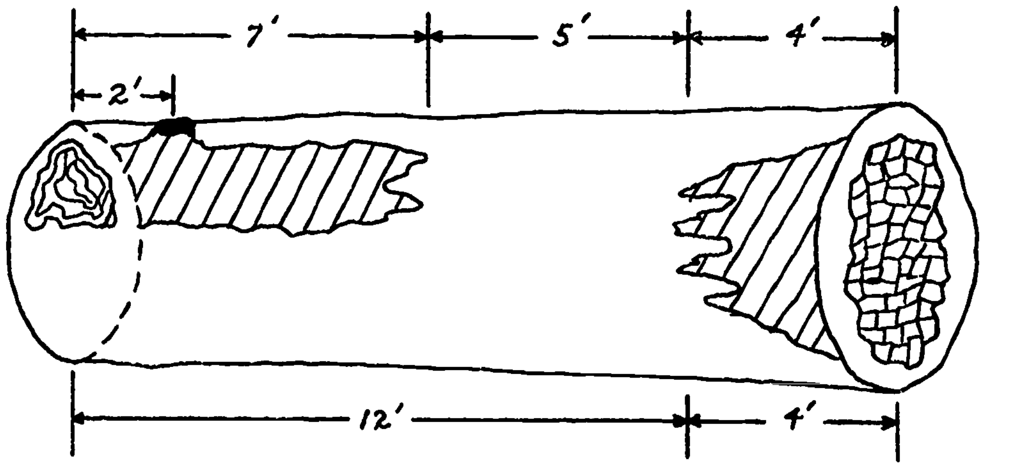


Figure 57.—Second-growth white pine log with Fomes pini punk and cubical butt rot.

to extend 4 feet into the log. Using Knouf's rule of thumb, one-third of the diameter of the defect is added to the diameter of the defect, since the defect diameter falls in the 10- to 19-inch range. By adding one-third of the diameter, or 4 inches, to the 12-inch diameter of the defect, the total is 16 inches, which, on the scale rule, reads 160 board feet. Because the defect is estimated to extend 4 feet into the log, one-fourth of the 160, or 40, would be the deduction, leaving a net scale of 360 board feet for the log.

Two separate defects are shown in the 16-foot white pine log in Figure 57: A *Fomes pini* punk 2 feet down from the top end of the log; and cubical butt rot caused by *Polyporus schweinitzii*, or velvet top fungus, in the butt end of the log. The *Fomes pini* punk indicates rot in half of a 7-foot section of the log. Deductions for this defect are calculated by the segment rule. The butt rot affects the full diameter of the butt for an estimated 4 feet, leaving only 5 feet of sound material in the top half of the log. Considering that 5-foot lumber is not merchantable, the entire upper half-section would be culled. The bottom half of the log shows 12 feet to be sound; therefore, the log would be given one-half the scale of a 12-foot log. This example illustrates precisely what is meant by a log's having 33⅓ per cent merchantable lumber as outlined under the information on merchantability, page 17.

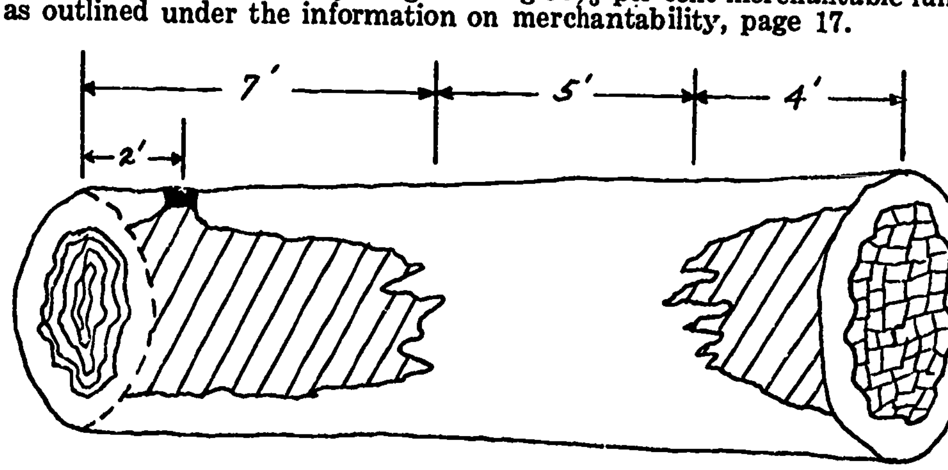


Figure 58.—Ponderosa pine log with Fomes pini punk and cubical butt rot.

Figure 58 shows two separate defects in a 16-foot ponderosa pine log: A *Fomes pini* punk 2 feet from the top end; and cubical butt rot caused by *Polyporus schweinitzii*, or velvet top fungus in the butt end of the log. The *Fomes pini* punk indicates rot in all of a 7-foot section of the log, except for the surrounding sapwood. The log would be culled unless the sound sapwood which falls outside the squared-out defect exceeds 33⅓ per cent of the gross volume of the log; in which case, the scaler would make deduction by Knouf's rule of thumb or by the squared defect method of deduction, plus allowance for the rotten knot associated with the *Fomes pini* defect.

2. FEATHER ROT—Caused by *Poria subacida*. Also known as spongy root rot, stringy butt rot, and white stringy rot.

SPECIES AFFECTED—Grand fir, Engelmann spruce, western white pine, ponderosa pine, Douglas fir, western hemlock, western redcedar. Also found on hardwoods.

ROT DESCRIPTION—Feather rot is one of the most common slash rots on conifer wood in Idaho, being found in dead standing trees, stumps, fallen trees, and stored logs; in addition, it occurs frequently as a butt and root rot of living trees, especially in western white pine. Faint pinkish to brownish discolorations of the wood mark the early stages; as decay progresses, elongated whitish streaks appear in the springwood. These streaks enlarge and run together, and the wood separates easily at the annual rings. Black flecks often appear among the white fibers. As decay continues, the wood breaks down into a whitish stringy mass of soft, spongy, watersoaked material. In the advanced stages of decay, cream-colored mats of fungous tissue with golden brown flecks usually develop in the wood. On the ends of logs, this rot is roughly circular in outline; the white, stringy nature of the decayed wood and the fungous tissue serve to identify it.

INDICATORS OF DECAY—Conks of *Poria subacida* are flat and crust-like with small circular pores. The perennial conks are cream to almost lemon yellow in color. Conks develop in root crotches of living trees and on the undersurface of dead material on the ground.

EXTENT OF DECAY—In old-growth timber, the rot characteristically hollows out the center section and leaves a clear shell. When an entire

Figure 59.—Feather rot, caused by Poria subacida, in grand fir.

Figures 60 and 61.—Feather rot in western white pine and western hemlock. Notice the stringy nature of the decayed wood and the white mats of fungous tissue.

cylinder is affected, deduction may be made by applying the length cut method or by a cylinder or hole deduction. In the earlier stages of decay, the deduction may be made by using the standard rule, Knouf's rule of thumb, or squared defect rule. This rot rarely extends beyond 16 feet in length and is confined to the butt log.

3. YELLOW RING ROT—Caused by *Poria weirii*.

SPECIES AFFECTED—Common in western redcedar and also occurs in western hemlock, Douglas fir, and grand fir.

ROT DESCRIPTION—This common butt rot in western redcedar in Idaho enters the tree through basal injuries, particularly fire scars. It is a common rot in fallen trees and cull logs left in the woods. Yellow ring rot also occurs as a heart rot of other conifers and may kill young Douglas fir and grand fir as a root rot. In the early stages, the wood shows a yellowish discoloration, which darkens as the wood becomes softer. The wood then begins to separate along the annual rings, and a definite ring shake develops. The thin layers of decayed wood usually have small elliptical pits parallel to the grain. Brownish strands of fungous tissue also appear between the layers. On ends of logs the rot may appear in crescent- or ring-shaped circular areas with conspicuous radial cracking. The thin layers of decayed wood can be readily pulled out of the log. In older infections, the butt may become hollow. These hollows are usually lined with the typical, laminated decayed wood.

INDICATORS OF DECAY—On living trees the conks develop under roots, in root crotches, and in hollow butts. They are perennial, dark chocolate brown in color, flat and crust-like, and rather soft and light.

EXTENT OF DECAY—Although yellow ring rot is usually confined to the butt log of western redcedar, it may extend up the trunk for 30 feet or more in severe decay.

Figures 62 and 63.—Yellow ring rot, caused by Poria weirii, in western redcedar logs.

Figure 64 shows a large cedar log, 34 inches in diameter, with a ring of defect, 16 inches in diameter on the small end and 20 inches in diameter on the large end, with a sound core in the center. As the log is 16 feet in length, the average diameter of the defect is used in making deductions.

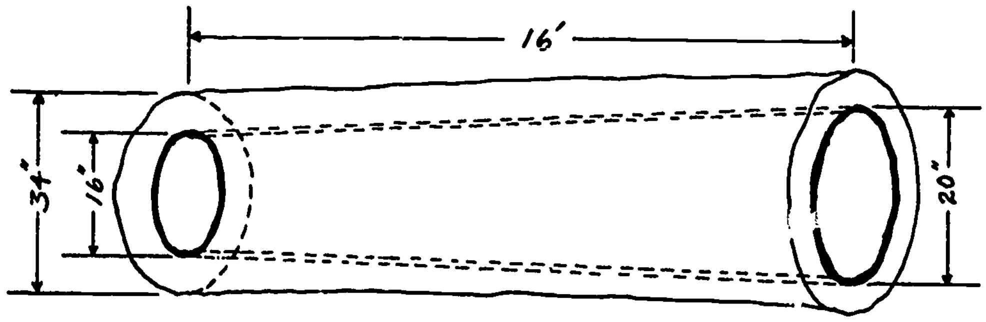


Figure 64.—Cedar log with yellow ring rot, caused by Poria weirii.

In using the standard rule, the scaler adds 1 inch to the average diameter and uses the formula as follows:

$$16+20=36\div 2=18+1=19$$

$$\frac{19\times 19\times 16}{15}=385 \text{ or } 390 \text{ board feet deduction}$$

A 16-foot log, 34 inches in diameter, gross scales 800 board feet; 800 less 390 leaves 410 board feet. The sound core of 15 inches scales 140 board feet; add the 140 to the 410, and the resulting net scale for the log is 550 board feet.

In using Knouf's rule, the scaler would add one-third of 18 inches or 6 inches, thus arriving at a total of 24 inches. A 16-foot log with a 24-inch diameter scales 400 board feet. Deduct the 400 from the gross scale of 800 board feet and the result is 400 board feet. By adding the scale of the sound core, or 140 board feet, the scaler arrives at a net scale of 540 board feet for the log.

NOTE: If the log had been less than 16 feet in length, the large diameter of the defect would be used making deductions.

4. BROWN POCKET ROT OF CEDAR—Caused by *Poria asiatica.*

SPECIES AFFECTED—Common in living western redcedar and as a slash rot in other conifers.

ROT DESCRIPTION—Although brown pocket rot in cedars is most commonly found in the butt, it may extend throughout the merchantable length of the tree. In the early stages of decay, a light brown discoloration appears; the wood becomes soft and loses its natural lustre. In the advanced stages, the wood cracks extensively and breaks down into a fragile, crumbly mass of brown cubes; and whitish or cream-colored fungous tissue develops in the cracks. The decay first develops in isolated, well-defined pockets. In the butt of the tree, these pockets run together and often form solid cylinders of rot. On ends of logs the rot commonly appears in small scattered pockets, concentric ring-shaped areas, or as solid circular areas. Large hollows often develop in the butt of older trees.

INDICATORS OF DECAY—Conks of *Poria asiatica* rarely, if ever, appear on living cedars, even when the decay is extensive and long-established. Consequently there is no specific indication of decay on the living tree. Conks develop on dead material and are abundant on slash of other conifers. They are white, thin and crust-like with small regular pores and have a very bitter taste.

EXTENT OF DECAY—In advanced stages of butt rot, the log may be treated in scaling as if longbutted above the point of swell; but, where the center is completely rotted, as shown in Figure 66, the hole is scaled out by applying the standard rule or Knouf's rule of thumb.

Figures 65 and 66.—Cedar brown rot caused by Poria asiatica. This rot appears in concentric rings or solid cylinders of rot.

5. RED ROOT AND BUTT ROT—Caused by *Polyporus tomentosus*.

SPECIES AFFECTED—Western white pine and ponderosa pine are the major hosts in Idaho. Engelmann spruce, western larch, lodgepole pine, Douglas fir, and western hemlock are also decayed by this fungus.

ROT DESCRIPTION—Red root and butt rot is generally confined to the lower portion of the butt log, the fungus entering the tree through basal scars or perhaps through injured roots. In the early stages of decay the wood is discolored, dark reddish-brown, and firm. In the later stages, narrow, lens-shaped pockets develop parallel to the grain. These pockets are filled with white decayed wood and are separated by reddish-brown firm wood. The rot is important only in living trees and is of little consequence in decay of slash.

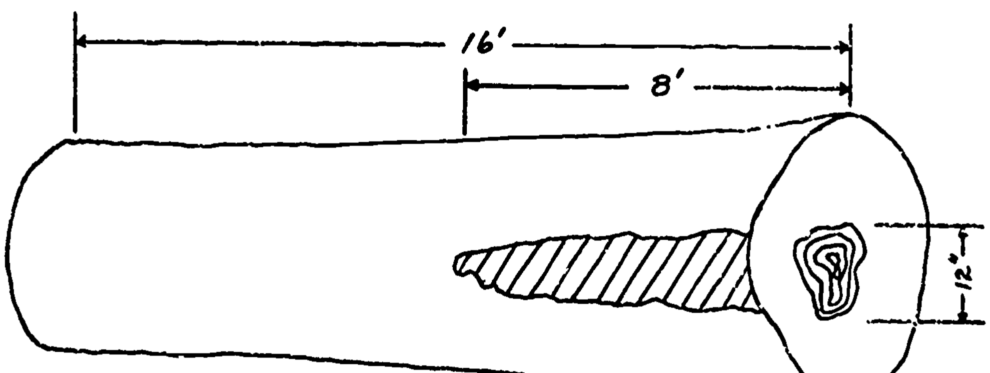


Figure 67.—Log infected with red root and butt rot, caused by Polyporus tomentosus.

INDICATORS OF DECAY—Conks of *Polyporus tomentosus* develop on the ground near the roots of a decayed tree or on the butt of the tree. Conks on the ground are stalked with a thin circular cap, and those on trees are usually thicker and more or less bracket-like. Both are yellowish-brown with a velvety or plush-like uppersurface.

EXTENT OF DECAY—This rot is generally confined to the basal portion of the first log and rarely extends beyond 6 or 8 feet. Deduction for this defect should be made in the same manner as for red-brown butt rot; that is, by the standard rule or Knouf's rule.

Polyporus tomentosus rot in Figure 67 extends 8 feet into a 16-foot log and is 12 inches in diameter. In using the standard rule for deduction, the scaler proceeds as follows:

$$\frac{13 \times 13 \times 8}{15} = \frac{1352}{15} = 90 \text{ board feet net deduction}$$

6. FOMES ROOT AND BUTT ROT—Caused by *Fomes annosus*. This rot is also called spongy sap rot, white pocket rot, and brown root and butt rot.

SPECIES AFFECTED—Western larch, Engelmann spruce, western white pine, whitebark pine, lodgepole pine, ponderosa pine, Douglas fir, western hemlock, and western redcedar.

ROT DESCRIPTION—*Fomes annosus* causes a root and butt rot of living trees and a common slash rot of conifers. In the early stages of decay the wood is firm and pinkish to reddish-brown in color. White pockets of decay appear in the discolored wood as decay progresses. These pockets are elongated parallel to the grain and frequently have black flecks in the center. The pockets enlarge and run together; the wood tends to separate at the annual rings, and a soft spongy mass of fibrous rotten wood with black flecks eventually results. In the early stages, the rot appears on the ends of butt logs as dark reddish-brown areas of discolored heartwood or as circular areas of whitish, spongy, decayed heartwood surrounded by a dark zone of early decay. Hollows may develop in older infections.

INDICATORS OF DECAY—Conks of *Fomes annosus* are perennial and are generally inconspicuous, developing under logs and roots or in root crotches of living trees. The uppersurface of the conk is gray to black with a hard smooth crust. The undersurface is cream-colored with small circular pores. Conks developing under logs or roots are commonly flat and cream-colored with a brownish-black margin. Resin flow may occur at the base of infected trees.

EXTENT OF DECAY—This rot is generally confined to the butt log and deduction should be made in the same manner as for previously described butt rots; that is, by the squared defect method, length cut, or Knouf's rule.

7. BIG POCKET ROT—Caused by *Fomes nigrolimitatus*.

SPECIES AFFECTED—Western larch, Engelmann spruce, western white pine, ponderosa pine, western hemlock, lodgepole pine, western red cedar, and Douglas fir.

ROT DESCRIPTION—Big pocket rot is common in fallen trees and cull logs and is occasionally found as a heart rot in the butt of living western redcedar. A reddish-brown discoloration develops in the early stages of decay. Later on, large irregularly-shaped pockets appear in the discolored wood. These pockets, elongated roughly parallel to the grain, are usually filled with white, fibrous, decayed wood and are separated by firm, apparently sound, reddish-brown wood. On the ends of logs, the large white pockets are conspicuous.

INDICATORS OF DECAY—Conks of *Fomes nigrolimitatus* are perennial; they are generally not noticeable and develop as crust-like patches on the underside of fallen trees and cull logs left in the woods. They are dark reddish-brown in color; when broken, they show fine blackish lines running through the tissue. When the conks develop as brackets on the sides of fallen trees and logs, the uppersurface is usually soft and spongy.

EXTENT OF DECAY—In determining the extent of decay for scaling purposes, this rot should be considered the same as trunk rot, using the standard rule or Knouf's rule of thumb for making deductions.

8. SHOESTRING ROOT ROT—Caused by *Armillaria mellea*.

SPECIES AFFECTED—Most conifers and hardwoods in Idaho are susceptible to shoestring root rot. It is particularly common on western white pine, ponderosa pine, Douglas fir, and grand fir.

ROT DESCRIPTION—*Armillaria mellea* causes the decay and death of sapwood in the roots and butts of living trees. Entering the tree through the roots and growing upward past the root collar, it often girdles the tree completely. In the early stages of decay, the wood appears watersoaked and shows a pale brownish discoloration. Eventually it becomes whitish, soft, and spongy or stringy with conspicuous narrow black zone lines running through the decayed wood. A white butt rot in the heartwood of older trees is also reported to be caused by *Armillaria mellea.*

INDICATORS OF DECAY—The presence of shoestring root rot may be indicated by abundant resin flow on the bark of the butt portion of the tree. Removal of bark from the root collar of infected trees reveals the presence of white fans of fungous tissue in the cambium region between bark and wood. Long, narrow, whitish to black strands of fungous tissue may be present under the bark and in the duff around the base of infected trees. These strands, called "rhizomorphs," have given rise to the common name of shoestring root rot. In the fall, conks of *Armillaria mellea* may develop at the base of infected trees and stumps; or they may develop on the ground from infected roots. The conks which often grow in dense clusters are honey-colored mushrooms with circular caps; the undersurfaces of the caps have radial gills.

EXTENT OF DECAY—Shoestring root rot usually extends up the trunk for only a few feet. When the defect affects only a portion of the scaling cylinder, deduction may be made by using the standard rule or Knouf's rule of thumb.

9. BROWN CUBICAL TRUNK AND SLASH ROT—Caused by *Polyporus sulphureus*. There is no popular name for this rot.

SPECIES AFFECTED—Western white pine, grand fir, western larch, ponderosa pine, Douglas fir, western hemlock, and Engelmann spruce.

ROT DESCRIPTION—*Polyporus sulphureus* decays the heartwood of living conifers and usually causes a butt rot. The rot is commonly observed in stumps and fallen trees. In the early stages of this rot, a brownish discoloration is observed; and the advanced stage is very similar to that of brown trunk rot. The wood becomes a brown, crumbly mass of more or less cubical chunks with conspicuous mats of white fungous tissue appearing in the cracks. On the ends of logs, the appearance of the rot is almost exactly like that of brown trunk rot; the cubical structure of the brown decayed wood and the white mats are very noticeable. The rot column is generally circular in outline; and, in trees with long-established rot, hollow butts are common.

INDICATORS OF DECAY—Conks of *Polyporus sulphureus*, often spreading profusely over a large area on the base of living trees, stumps, and fallen trees, are annual, thin, and bracket-like. They are a bright orange on the uppersurface and sulphur yellow on the undersurface, which has small circular pores. Fading out as the conk ages or is dried, the bright tones eventually become straw-colored or almost white; the conks deteriorate rapidly in the late fall. Living trees are infected through basal wounds and dead branch stubs.

EXTENT OF DECAY—This rot is generally confined to the butt log and is one of the more common butt rots. Deductions are usually made by the length cut method.

Figure 68.—Polyporus sulphureus in western hemlock.

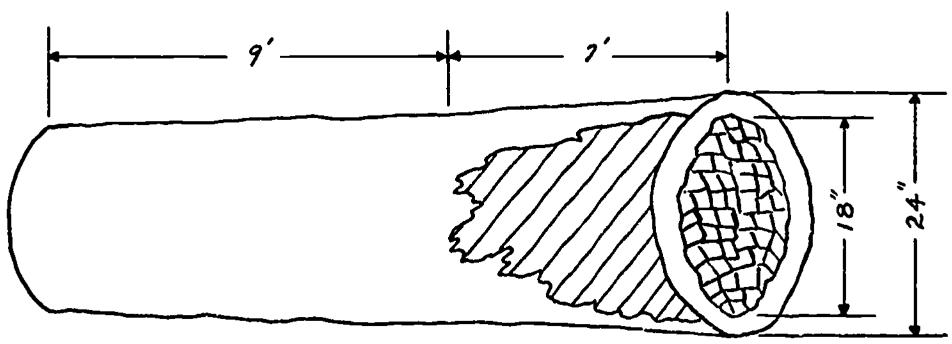


Figure 69.—Douglas fir log with brown cubical trunk rot, caused by Polyporus sulphureus.

Figure 69 pictures a 16-foot Douglas fir log with *Polyporus sulphureus*. The rot is estimated to extend 7 feet into the log and culls 7 feet of the butt area. By applying the length cut method, the result is 9 feet of sound material. As 9-foot lumber is considered unmerchantable because of its odd length, the scale would be computed on an 8-foot length, which, in this instance, represents half the gross scale of the log.

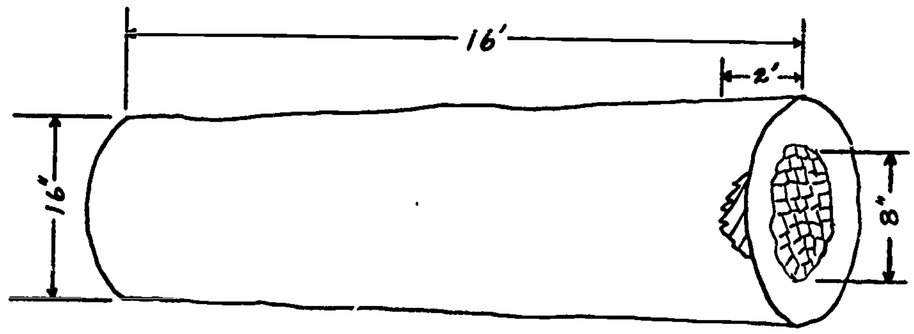


Figure 70.—Brown cubical trunk rot in the butt of a log.

The rot shown in Figure 70 has affected approximately half the diameter of the log for an estimated 2 feet into the log. The deduction for defect would be half of a 2-foot length cut. A 16-foot log with a 16-inch diameter scales 160 board feet; a 2-foot section scales 20 board feet, and half of a 2-foot section scales 10 board feet; 10 deducted from 160 leaves a net scale of 150 board feet for the log.

If the rot were estimated to extend for a greater distance into the log, deduction should be made by the standard rule or Knouf's rule of thumb.

C. SAP ROTS AND STAINS

The ability to make proper deductions for sapwood defects is essential to a good scaler. Because a large proportion of the scale of a log is in the outer few inches of wood, consistent errors in estimating the amount of unsound sapwood may lead to sizable differences between log scale and actual yield.

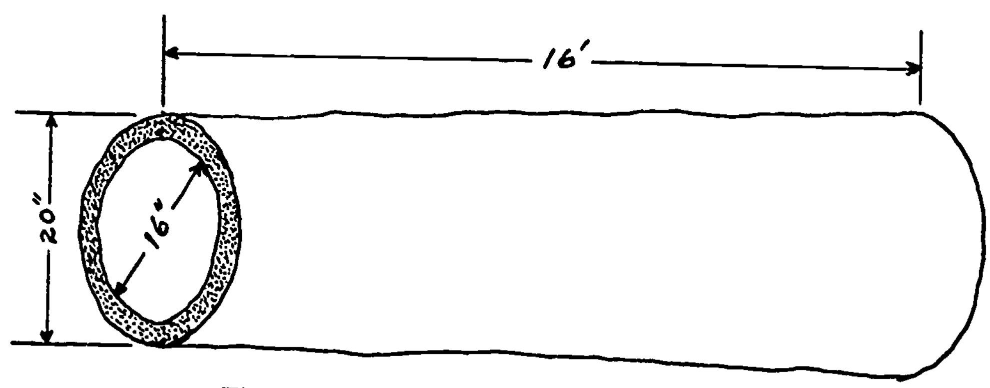


Figure 71.—Log showing unsound sapwood.

As an example of the effect of unsound sapwood on the scale of a log: A 16-foot log, 20 inches in diameter, gross scales 280 board feet. The same log with a 2-inch shell of rotten sapwood has a deduction of 120 board feet, or a net scale of 160 board feet. The scaler should bear in mind that, if the deduction reduces the net scale of the log below the merchantability clause, which is generally 50 per cent in associated species and 33⅓ per cent in the pines, the log is culled. For example, if the sound core in this same log were only 14 inches, the deduction would be 170 board feet, which would be sufficient to cull an associated species log.

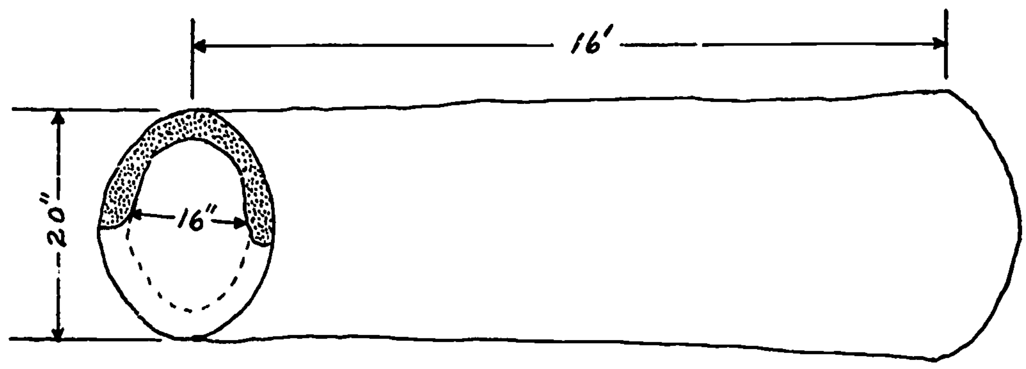


Figure 72.—Unsound sapwood extending halfway around the log.

Figure 72 shows a log, 20 inches in diameter, scaling 280 feet gross scale, with a 2-inch sap rot extending halfway around the circumference. To scale a log of this type, simply rule from the inside of the defective portion to the outside of the sound portion of the log, giving it a net scale of 210 board feet.

In deducting for sap rots or other defects, care must be taken not to deduct for defects that are outside the scaling cylinder. Figures 73 and 74 illustrate this point.

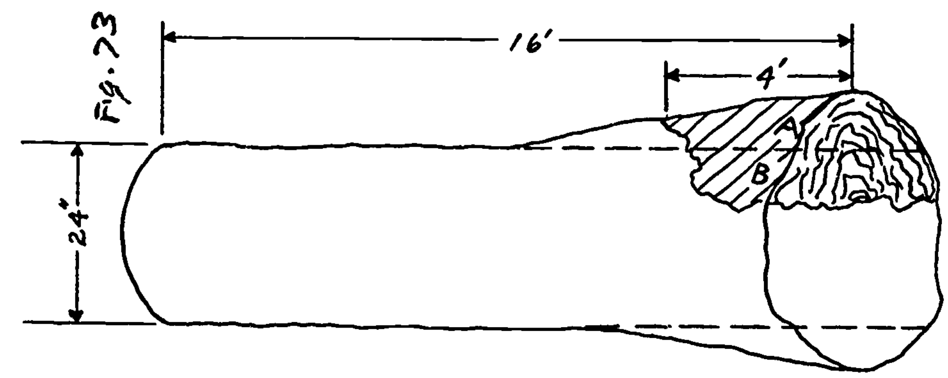


Figure 73.—Log with sap rot or other defects, occurring both inside and outside the scaling cylinder.

Figure 73 shows a sap rot or other defect that could have been caused by a cat face, fire scar, sap rot, or other rot. As the portion "A" is outside the scaling cylinder, deduction is made for "B" only. It is estimated that one-third of a 4-foot section is lost because of the defect. Being 24 inches in diameter, the log scales 400 board feet; a 4-foot section scales 100 board feet; one-third of 100 rounded to the nearest 10 allows a deduction of 30 board feet for the defect; 400 less 30 leaves a net scale of 370 board feet for the log.

Figure 74 shows a defect occurring outside the scaling cylinder of the log. No deduction is made for this defect.

In some cases, when dead timber is cut or when logs from green timber are decked for long periods of time, unsound sapwood becomes a problem.

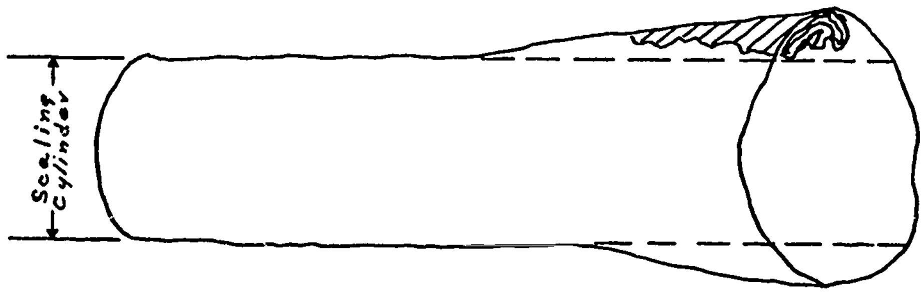


Figure 74.—Sap rot or other defect outside the scaling cylinder of the log.

During the breaking-down process of the wood, it is quite difficult to distinguish between sound sapwood and unsound sapwood; however, the following information may serve as a guide in determining the condition of logs.

Any one of the following will indicate unsound sapwood:
- Black sapwood from end to end of the log.
- Brown pockets of rot (more evident in fresh logs).
- Sapwood soft and separated from the heartwood.
- Conks of sap rot fungi on logs.

Any two of the following will indicate unsound sapwood:
- Worm holes.
- Weather checks on entire surface of log and its ends.
- Dark blue stain (probably in association with brown rot).

1. PITTED SAP ROT—Caused by *Polyporus abietinus*. This rot is also known as hollow pocket rot.

SPECIES AFFECTED—Virtually all conifers in Idaho with the possible exception of junipers and Pacific yew.

ROT DESCRIPTION—Pitted sap rot is one of the most common decay fungi on stumps, logs, and slash in the woods; it also develops on decked sawlogs and pulpwood. Occasionally it decays dead sapwood on cat faces on living trees. *Polyporus abietinus* does not cause heart rot of living trees, although heartwood on dead material may be decayed. The first evidence of decay is a yellowing and softening of the wood. Tiny empty pockets that are elongated parallel to the grain appear. As decay progresses, these pockets become larger and more numerous until the wood has a fragile, lace-like appearance. Pitted sap rot develops rapidly in wood that still has bark on it.

INDICATORS OF DECAY—Conks of *Polyporus abietinus* usually develop abundantly on decaying material. They are flat and crust-like on the undersurface of logs and slash; and they are thin and bracket-shaped on dead standing trees, stumps, and the uppersurfaces of down material. The conks are gray with faint radial zones on the uppersurface and purplish with large irregular pores on the undersurface. As the conks age, the purple color fades to a pale brown. On the sapwood on the ends of logs, the conks commonly appear in large numbers, sometimes completely covering it.

EXTENT OF DECAY—As conks develop readily on the bark over the entire surface area of the decaying sapwood, the distribution of the conks usually indicates the extent of decay. Sapwood of logs on which conks of *Polyporus* *abietinus* appear is considered unsound and should be deducted for accordingly. Such logs are scaled inside the affected sapwood. See Figure 71 or 72, whichever is applicable.

2. GRAY SAP ROT—Caused by *Polyporus volvatus*.

SPECIES AFFECTED—Grand fir, Engelmann spruce, ponderosa pine, Douglas fir, western hemlock, and western larch.

ROT DESCRIPTION—Gray sap rot develops very rapidly in dead standing trees and is common in recently-cut stored logs, particularly grand fir logs and pulpwood. The rot is generally superficial, being limited to the outer ¼ inch of sapwood. Dark gray streaks and flecks appear in the wood, which remains quite firm.

INDICATORS OF DECAY—Conks of *Polyporus volvatus* usually appear on trees the year after death occurs, often developing by the thousands over the entire trunk surface as well as on the larger branches. These conks indicate the rapid and extensive development of the decay in the newly-dead sapwood. Apparently conks develop during one season, are quickly deteriorated by insects, and do not occur again on a particular tree. They are cream-colored and often resemble small eggs attached to the bark of a tree. Larger conks, up to 2 inches in diameter, are more or less hoof-shaped. The underside of the conk has a small circular hole near the base, opening into a cavity which frequently contains insects that spread the spores of the fungus.

EXTENT OF DECAY—Because of the superficial nature of this rot, no deduction is made unless the sapwood is broken down. If the sapwood is broken down, deduction should be made by scaling inside the affected area. See Figure 71 or 72, whichever is applicable.

3. BROWN SAP ROT—Caused by *Lenzites saepiaria*, *Trametes americana*, and *Trametes serialis*. Many other fungi cause a brown cubical sap rot and the ones listed are those most commonly found.

SPECIES AFFECTED—All commercial conifers in Idaho. *Lenzites saepiaria*, and *Trametes serialis* are occasionally found on living trees, on dead sapwood under fire scars, and on other wounds. Advanced decay is characterized by a mass of crumbly, brown cubical wood that may or may not have thin mats of fungous tissue in the cracks in the wood. Decay on fallen trees, stumps, snags, and smaller material on the ground usually begins in the sapwood, which is rapidly destroyed, and progresses into the heartwood, which is also eventually decayed.

INDICATORS OF DECAY—Conks of these fungi are annual, tough, and persistent. *Lenzites saepiaria* conks are brownish, thin, and bracket-like, and have radial gills on the undersurface. *Trametes americana*, which are similar, have large circular pores on the undersurface. *Trametes serialis* conks are white, flat, and crust-like, with large circular pores.

EXTENT OF DECAY—Brown sap rot indicates that the entire sapwood is unusable for lumber or pulp and that the log should be scaled inside the defective sapwood. See Figure 71 or 72, whichever is applicable.

4. BROWN CRUMBLY ROT—Caused by *Fomes pinicola*.

SPECIES AFFECTED—Common on virtually all conifers; occasionally decays birch, aspen, and cottonwood.

ROT DESCRIPTION—This rot is probably the most important slash rot of conifers in Idaho. It occurs on dead standing trees, fallen trees, sawlogs, and pulpwood in storage. The rot usually develops in the sapwood, which is decayed rapidly, and then progresses into the heartwood. It has been reported as an occasional heart rot in living trees, entering the heartwood through basal scars; but its major role is in decay of slash and stored logs. The early stage of decay is marked by a faint brownish discoloration. In the later stages, the wood is reduced to a yellowish-brown to reddish-brown mass of cubical chunks with white mats of fungous tissue developing in the cracks in the decayed wood. The sapwood of dead spruce and pine is destroyed quite rapidly; where logs of these species are kept in decks for long periods, the losses in higher grades of lumber or pulp yields may be considerable.

INDICATORS OF DECAY—Conks of *Fomes pinicola* develop readily on dead standing and fallen trees and on stored logs. They are perennial, woody, and hoof-shaped to rather thin and bracket-like. The uppersurface is crusted, gray to blackish, and often has a distinct reddish band around the margin. The undersurface is smooth and cream-colored with very small, circular pores. Small, whitish, crust-like conks often develop extensively over the sapwood on ends of decaying stored logs.

EXTENT OF DECAY—Because sapwood is vigorously attacked by this rot, scaling is generally accomplished by scaling inside the affected sapwood. See Figure 71 or 72, whichever is applicable.

Figure 75.—Fomes pinicola in hemlock.

5. SAP STAIN OR BLUE STAIN—Caused by a large number of fungi, including species of *Ceratocystis*, *Graphium*, and *Leptographium*. Sapwood of virtually all species may be stained to some extent; but white pine, ponderosa pine, lodgepole pine, and Engelmann spruce are particularly susceptible.

Blue stain in logs is not considered a defect for which deduction should be allowed, as sound or firm blue-stained lumber is merchantable. No deduction should be made in scaling logs affected with blue stain, unless the sapwood is broken down or rotten.

In the latter case, the decay can be traced to some of the true wood-destroying fungi. The conditions favorable for the development of the bluing fungi—high moisture content and warm weather—are also highly favorable to the development of the true wood-destroying fungi; hence logs attacked by bluing fungi may at the same time be attacked by various fungi-producing decay.

In scaling blue-stained logs, which have broken down, or rotten sapwood, deduction for the waste portion must be made; such logs should be scaled

Figure 76.—Blue stain in Idaho white pine. Not considered a defect except in advanced stages, when it is usually associated with sap rot.

to the average diameter inside the rotten sapwood. See Figure 71 or 72, whichever is applicable.

D. ROTTEN OR HOLLOW KNOTS

Rotten or hollow knots, other than the punk knot which is associated with white pocket rot, etc., will reduce the amount of merchantable lumber in a log and must be taken into consideration. A reduction of 1 inch in diameter is made for each face affected by such knots, provided that no other deduction includes these same rotten knots.

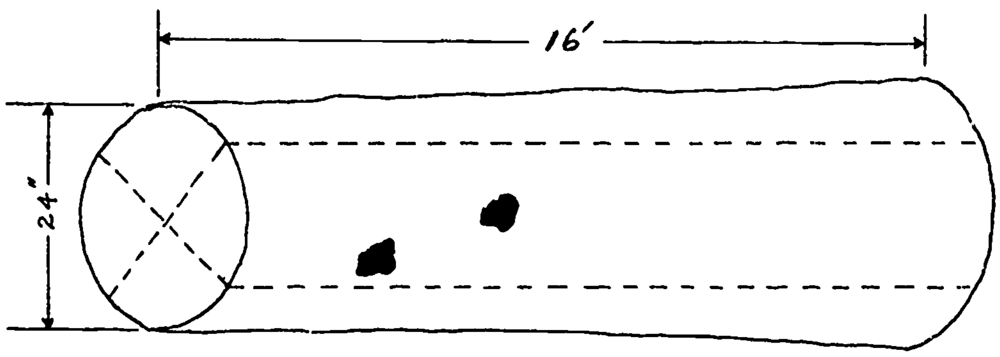


Figure 77.—Log with rotten or hollow knots.

Figure 77 illustrates a 16-foot log with a 24-inch diameter having two rotten knots, both of which are in one face. A diameter reduction would be made if the log had no other indications of rot. A 24-inch log, 16 feet long, scales 400 board feet. Inasmuch as the rotten knots affect only one face of the log, the diameter of the log is reduced to 23 inches. A 23-inch log, 16 feet long, scales 380 board feet. The amount of deduction would be 400 minus 380, or 20 board feet.

OTHER NATURAL DEFECTS

1. Shake and Pitch Ring—Shake and pitch rings are common to the following species: White fir, larch, Douglas fir, hemlock, and redcedar.

The scaler should bear in mind that pitch and shake rings follow annual rings and that deductions should not be made for defect that falls outside the scaling cylinder. He should also bear in mind that a ring that opens wide may have deep penetration into the log and that numerous rings may penetrate deeper than one or two rings. It is very important for the scaler to make sawmill visits in order to develop judgment in making deductions for shake and pitch rings.

If a pitch or shake ring is within 3 inches of the diameter of the scaling cylinder, the scaler will scale inside the ring, for no merchantable lumber can be obtained from the portion outside the ring.

If the ring is 6 inches or less in diameter, the sound portion left in the center is too small to yield merchantable lumber. The standard rule or the squared defect method is used to deduct for this ring.

Table 5 will be helpful in determining deductions for shake and pitch ring defects.

TABLE 5

U.S.D.A.—FOREST SERVICE
PITCH AND SHAKE RING DEDUCTION CHART

Diameter of Ring	Deduction for 16 ft. Type of Ring		Diameter of Ring	Deduction for 16 ft. Type of Ring	
	Tight	Open		Tight	Open
All Deductions Shown in Decimal C					
6″	3	5	21″	22	26
7″	4	6	22″	23	28
8″	6	8	23″	23	29
9″	7	9	24″	26	32
10″	8	9	25″	26	32
11″	8	11	26″	28	34
12″	10	13	27″	29	35
13″	11	14	28″	32	38
14″	13	16	29″	35	41
15″	13	17	30″	37	43
16″	15	19	31″	41	45
17″	17	21			
18″	18	22			
19″	19	23			
20″	19	24			

Note: Reduce figures proportionately for shorter lengths. For example: If defect extends 8 feet, divide deductions given by 2.

Table shows for *full ring*. For ¾ take ¾; for ½ take ½; for ¼ ring or less, use squared defect method.

PITCH AND SHAKE RING DEDUCTION CHART INSTRUCTIONS

1. Obtain ring diameter. (Measure inside ring in an "open" ring.) Treat as a full ring to start.
2. Judge the ring as "tight" cr "open."
3. Apply the figures in the chart. For example: A 16′ x 24″ log shows a full tight ring in the butt end. The diameter of the ring is 12″, the estimated length 8′. The chart shows a deduction of 10 for a 16′ length, or 5 for the 8′ length.
4. *For a half ring,* take half the deduction for a full ring for the length affected.
5. *For a three-quarter ring,* take three-quarters the deduction for a full ring for the length affected.

Figure 78. — Western larch log with shake ring.

Figure 79. — Douglas fir log with pitch ring.

Figure 80. — Douglas fir log with pitch seam.

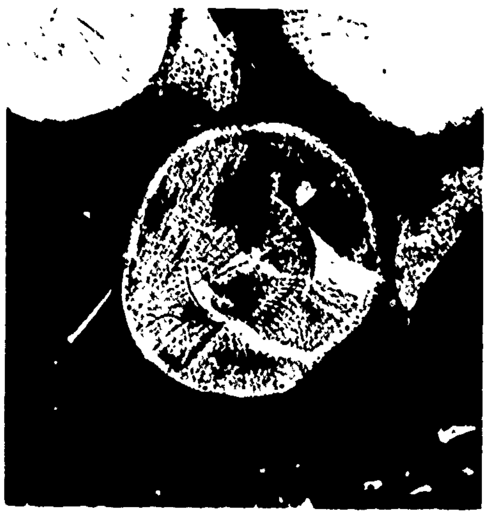


Figure 81. — Western larch log with pitch ring.

6. When *2 full rings* occur within one-half inch of each other, measure diameter of the inner ring and treat as an open ring.

7. When *2 full rings* are from ½″ apart to 2½″ apart, measure diameter of outside ring. Add 1″ if "tight," 2″ if "open," apply squared defect method for gross deduction. Reduce this by the scale of a log with a diameter of the inner ring.

8. When *2 full rings* are over 2½″ apart, measure diameters of both rings, determine whether "tight" or "open" and refer to the proper columns for deductions. Add deductions together.

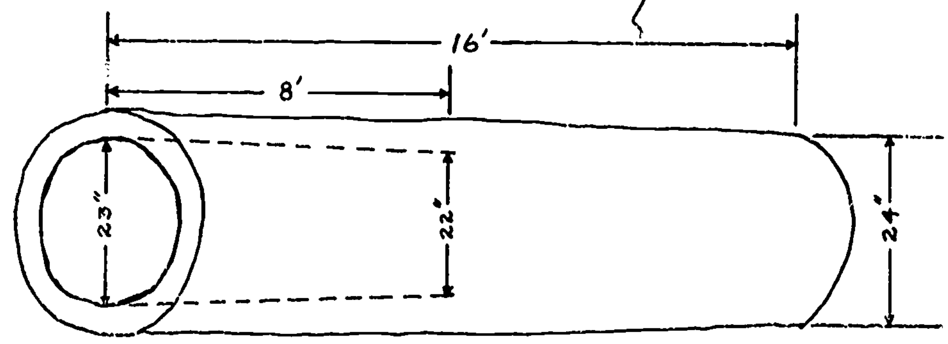


Figure 82.—Pitch ring in larch log.

Figure 82 is an example of a full pitch ring, averaging 23 inches in diameter and extending 8 feet into the log. The ring falls within 3 inches of the diameter of the scaling cylinder; therefore the net scale of the log would be the area inside the pitch ring only, inasmuch as no merchantable lumber could be obtained from the area between the pitch ring and the scaling cylinder. A 16-foot log, 24 inches in diameter, scales 400 board feet. A 16-foot log, 23 inches in diameter, scales 380 board feet, or a deduction of 20 board feet. This would be the net scale of the log if the pitch ring extended the full length of the log; as the pitch ring extends only through 8 feet of the log, the total deduction is 10 feet, or 390 board feet net scale for the log.

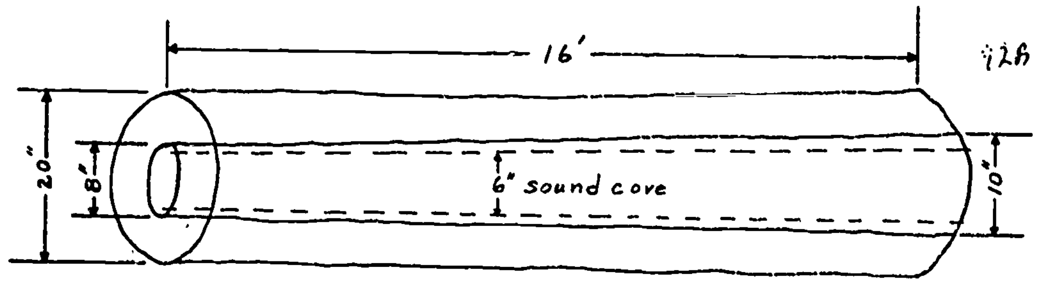


Figure 83.—Shake ring in larch log.

This sketch shows a 16-foot larch log, 20 inches in diameter, scaling 280 board feet. The log contains shake averaging 9 inches in diameter extending through its full length. Inside the shake ring is a 6-inch solid core. Using the standard rule, 1 inch is added to the 9-inch diameter and calculations are as follows:

$$\frac{10 \times 10 \times 16}{15} = 106 \text{ to the nearest } 10 = 110 \text{ board feet gross deduction}$$

The 6-inch core scales 20 board feet. This amount is subtracted from the 110 board feet gross deduction, leaving 90 board feet as the net deduction. The net deduction, 90 board feet, is subtracted from the gross scale of the log, 280 board feet, leaving 190 board feet as the net scale of the log.

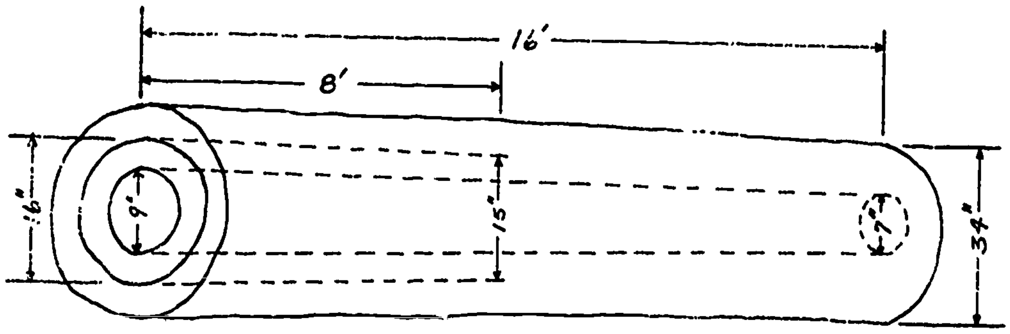


Figure 84.—Log showing two pitch rings.

Figure 84 shows a 16-foot log, 34 inches in diameter, scaling 800 board feet. The log contains a shake ring with an 8-inch average diameter extending through the full length. The log also contains another shake ring in the butt end that averages 16 inches in diameter and is estimated to extend 8 feet into the log. Two steps are necessary in calculating deductions for these defects.

By using the standard rule and starting with the larger ring which is 16 inches in diameter and is estimated to be 8 feet in length, the scaler adds 1 inch to the defect and makes deductions as follows:

$$\frac{17\times17\times8}{15} = \frac{2312}{15} = 154 \text{ to nearest } 10 = 150 \text{ board feet gross deduction}$$

The 15-inch core is treated as sound material and must be subtracted from the 150 board feet gross deduction. An 8-foot log, 15 inches in diameter, scales 70 board feet. Thus, by subtracting the 70 board feet from the 150 board feet gross deduction, a net deduction of 80 board feet for the larger shake ring is obtained.

Using the standard rule on the small ring which extends the full length of the log, the scaler adds 1 inch to the defect and calculates as follows:

$$\frac{9\times9\times16}{15} = \frac{1296}{15} = 86 \text{ to nearest } 10 = 90 \text{ board feet gross deduction}$$

The 7-inch sound core inside the smaller ring scales 30 board feet. This scale would be deducted from the gross deduction of 90, leaving a net of 60 board feet as the deduction for the small ring. The net scale of this particular log would be 800 minus 140 (80 plus 60) or 660 board feet.

2. MASSED PITCH—Massed pitch is found chiefly in ponderosa pine. Deduction for this defect should be made by the standard rule or length cut.

3. HEART CHECK—Heart check will result in a loss of merchantable lumber; therefore the scaler must make deduction for this defect if the log is to be used for the manufacture of lumber. Heart check may extend through the entire length of the log, or it may show at only one end of the log; in

Figure 85.—Massed pitch in ponderosa pine butt log.

Figure 86.—Heart check in western redcedar log.

Figure 87. -Heart check in western larch log.

Figure 88.—Heart check in grand fir log.

which instance the scaler must estimate the distance which it extends into the log. If the check extends across the entire end of the log, the maximum length of the defect will not exceed the slabbed area, falling within the scaling cylinder.

Common methods of determining the deduction for heart check are the standard rule and the squared defect method.

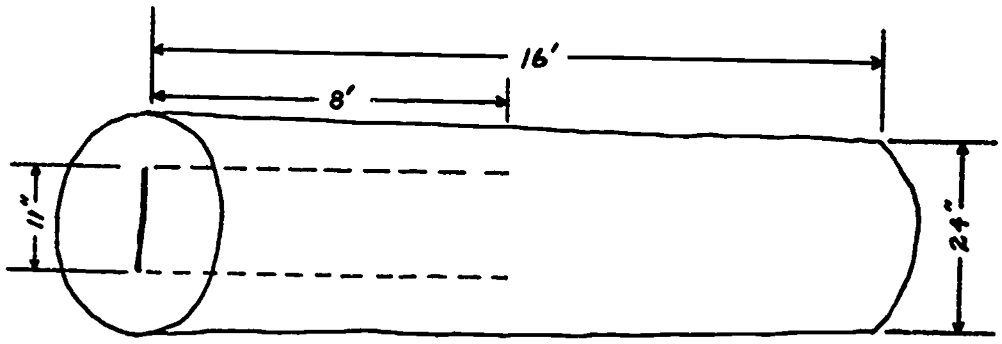


Figure 89.—Log with heart check.

Figure 89 shows a 16-foot log, 24 inches in diameter, with a 1-inch by 11-inch heart check, which is estimated to run one-half the length of the log. By using the squared defect method, the scaler adds 1 inch to both the width and length of the defect and makes deduction as follows:

$2 \times 12 = 24$ to next higher $10 = 30$

$30 \times \frac{8}{16} = 15$ to the nearest $10 = 20$ board feet deduction

A 16-foot log, 24 inches in diameter, scales 400 board feet. The net scale of the log would be 400 minus 20, or 380 board feet.

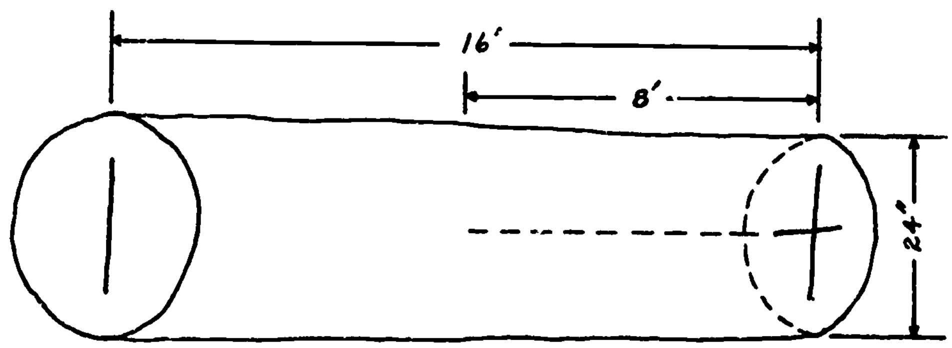


Figure 90.—Log with two heart checks.

Figure 90 shows a 16-foot log, 24 inches in diameter, with a 1-inch by 16-inch heart check, which runs through the entire length of the log. In addition, there is another heart check measuring 1 inch by 12 inches, which is estimated to run one-half the length of the log. You will note that the latter check overlaps or lies across the first check. By using the standard rule or the squared defect method, make deductions for these two checks as follows:

First check: $2 \times 17 = 34$ raised to the next higher $10 = 40$ board feet deduction for the first check.

Second check: The gross measurements for the second heart check would be 2 inches by 13 inches; but because of the overlap of the two heart checks, the correct measurements to consider are 2 inches by 11 inches. Using the squared defect method, make calculations as follows:

$2 \times 11 = 22$ to the next higher $10 = 30$

$\frac{30 \times 8}{16} = 15$ to the nearest $10 = 20$ board feet net deduction

The total deduction for both checks would be 40 feet first check, 20 feet second check, or 60 board feet. The gross scale of this log is 400; thus, 400 minus 60 leaves 340 board feet net scale for this particular log.

4. SPIRAL HEART CHECK—When checks or pitch seams spiral or turn in a log, the deduction is usually calculated by the squared defect method. If the check or seam turns or spirals 45 degrees or less from one end of the log to the other, add 50 per cent to the deduction. If the check or seam turns or spirals 46 to 90 degrees, double the deduction.

Example: If straight, a 2-inch by 18-inch pitch seam, running the full length of a 16-foot log, calls for 40 board feet deduction; if the seam spirals 30 degrees, add 50 per cent or 20 board feet, making a total of 60 board feet deduction. If the seam spirals 75 degrees, double the deduction, making a total deduction of 80 board feet.

5. FROST CHECK—Frost checks are common in the butt logs of white fir and hemlock because of their high water content and subsequent freezing during cold weather. This defect usually extends from the surface of the log to the heart and may extend up from the butt end of the log 8 or 10 feet. The frost check can be traced on the surface of the log by a ridge of bark extending the length of the frost seam; or, if the log is debarked, by the outside irregularities of the sapwood. The scaler can judge the length of the defect by the length of the bark ridge or the irregularities of the sapwood.

Figure 91.—White fir butt log with shake and frost checks. When used for lumber, this type of log should be long-butted in the woods.

In making deductions for this defect, the scaler should remember that deductions which exist outside the scaling cylinder will not be taken. He should also bear in mind that there is a slabbed area inside the scaling cylinder, which is lost in sawing. The Scribner rule in its construction makes allowance for this slab. The standard rule or its derivatives do not take this slab loss into consideration. It is standard policy to allow 1 inch on the radius inside of the right cylinder for the slab loss.

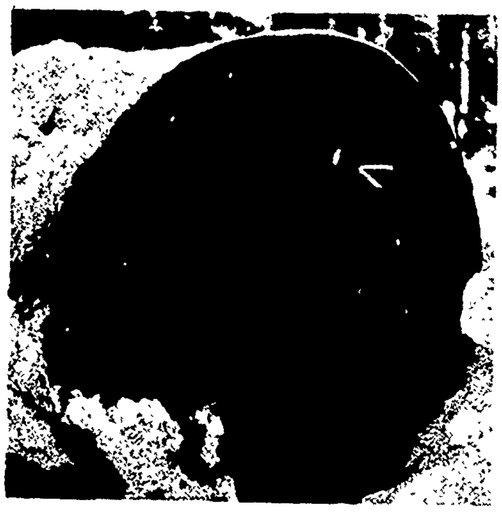


Figure 92.—White pine log badly checked, having some lumber value.

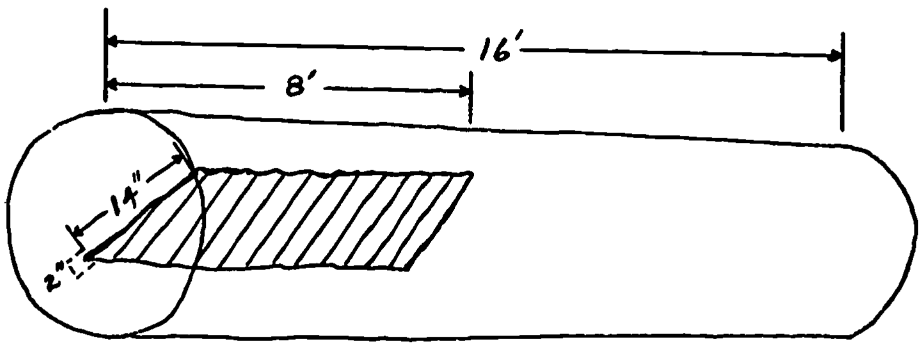


Figure 93.—Log with a frost check.

Figure 93 shows a 16-foot white fir log with a frost check extending 8 feet from the butt of the log. When 1 inch is allowed for the outside slab, the depth of the check is 14 inches. The loss from the width of the check is 2 inches.

Using the standard rule for deduction and adding an inch to the diameters of the defect, proceed as follows:

$$\frac{3 \times 15 \times 8}{15} = 24 \text{ to the nearest } 10 = 20 \text{ board feet}$$

To use the squared defect method of deducting for this defect, proceed as follows:

$$3 \times 15 = 45 \text{ to the next higher } 10 = 50 \text{ board feet}$$

This represents the defect for 16 feet. As the frost check extends only 8 feet into the log, one-half of this amount to the nearest 10, or 30 feet should be deducted.

6. Bark Seam—Bark seam is another natural defect that generally extends inward from the outer edge of the log. Usually deductions are made in the same way as for frost checks.

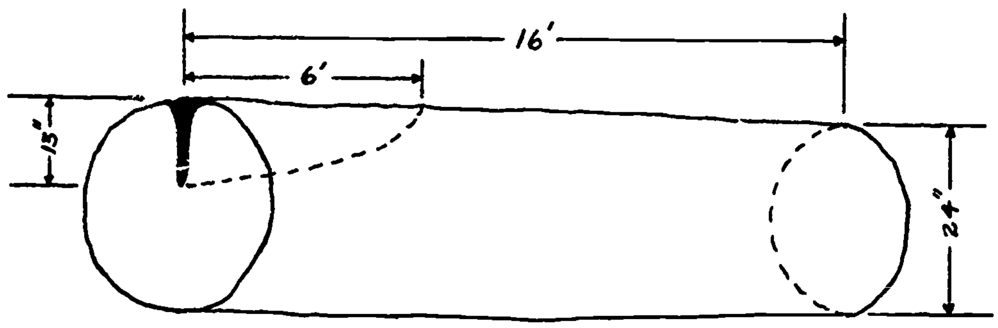


Figure 94.—Log with a bark seam.

Figure 94 shows a 16-foot log, 24 inches in diameter, with a bark seam which is 3 inches wide, 13 inches high, and appears to affect 6 feet of the log. The outer 3 inches of this defect fall outside of the scaling cylinder and 1 inch of the defect falls within the slab area of the scaling cylinder; therefore, the net area to be considered is 3 inches wide, 9 inches high, and 6 feet long. By applying the standard rule and adding 1 inch to both the width and length of the defect:

$$\frac{4 \times 10 \times 6}{15} = 16 \text{ to the nearest 10, or 20 board feet deduction}$$

The gross scale of a 16-foot log, 24 inches in diameter, is 400 board feet. The net scale of this particular log would be 400 minus 20, or 380 board feet.

7. Season or Wind Checks—When a number of deep checks extend from the greater part of the surface toward the center of the log, the scaler should measure the diameter of the sound core within the largest circle which can be scribed on the scaling end without being seriously cut into by checks. All material outside of this circle should be thrown out as defective. If the core of solid material is smaller at the butt than at the top end, the butt measurement should be taken as the scaling diameter.

Because the checks are always more obvious at the sawed ends, the scaler should measure the diameter about halfway between the outer edge of the cross section and the inside edge of the deepest checks.

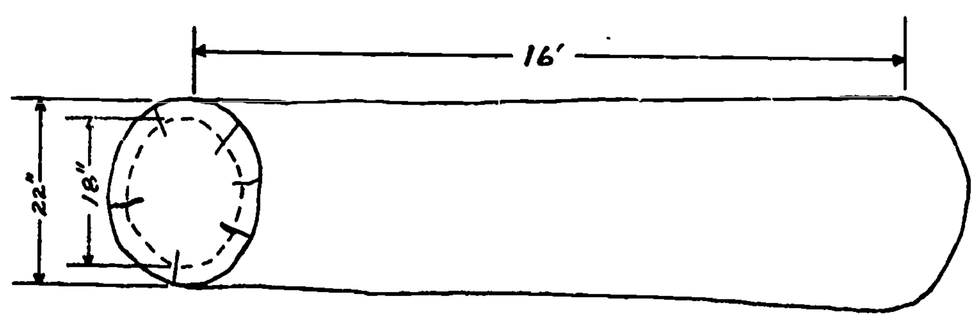


Figure 95.—Season or wind checks.

Figure 95 illustrates the method used in scaling a log cut up by numerous deep checks. It shows a 16-foot log, 22 inches in diameter at the top end, scaling 330 board feet, cut up by several checks extending about 4 inches from the outer surface toward the center of the cross section of the log. Taking the average diameter halfway between the outer edge of the log and the inner edge of the checks, this log should be scaled to an 18-inch diameter, thus discounting 2 inches from the outer surface all the way around the log. A 16-foot log, 18 inches in diameter, scales 210 board feet, the net scale of the log in Figure 95.

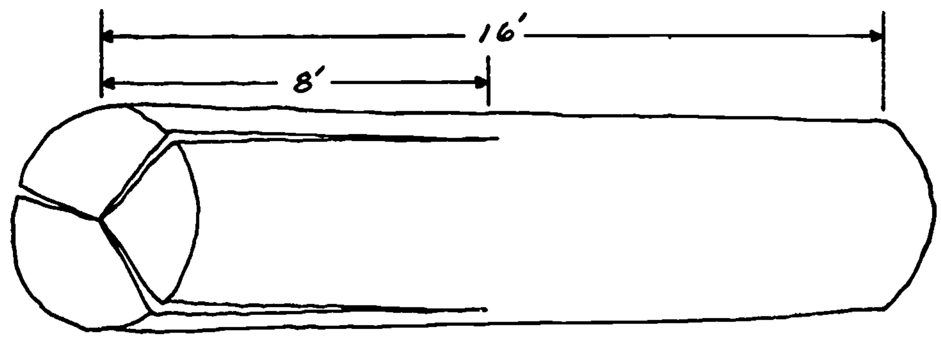


Figure 96.—Log with season checks.

Figure 96 shows a 16-foot log with three straight season checks extending from the surface of the log into the heart. These checks extend approximately 8 feet up the log from the butt. It is estimated that one-half of the log is lost from these checks. A simple and quick way to calculate for a defect of this nature is to deduct one-half of an 8-foot section and scale as a 12-foot log. If these checks had spiraled around the log as is common in spruce, the scalrr would deduct 8 feet or one-half of the log from the gross scale.

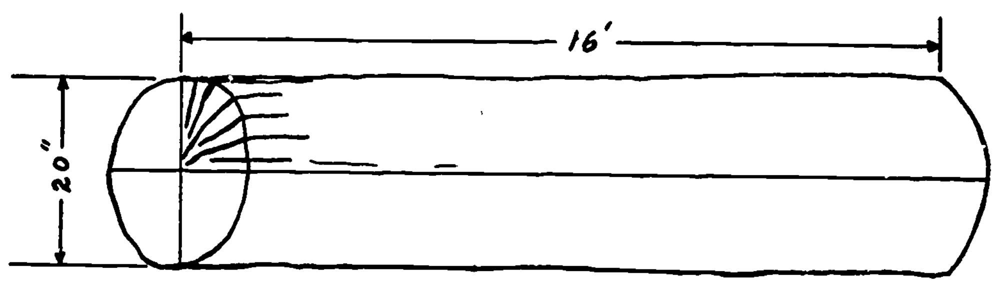


Figure 97.—Season or wind checks in one portion of a log.

The log in Figure 97 is 16 feet long and has a 20-inch top diameter, scaling 280 board feet, with wind checks 8 to 10 inches deep in one portion of the log. By using the segment method, most of the checks can be included in one segment, which comprises one-fourth of the log shown in Figure 97; consequently, the gross scale would be reduced one-fourth, or 70 board feet.

In calculating the amount of waste in segments, the rapid scaler usually refers to the scale rule and reduces the log length by the same fraction as is represented by the segment wasted. Thus, if a segment comprising one-fourth or one-third of a log was wasted, the scaler would drop one-fourth or one-third of the log length.

8. BURLS, KNOT CLUSTERS AND MISTLETOE GALLS—Burls, knot clusters, and mistletoe galls must be considered by the scaler; and deductions for these defects must be made if the burl or knot cluster will affect the volume of merchantable lumber in a log. The usual method of deducting for these defects is the length cut, or the segment rule.

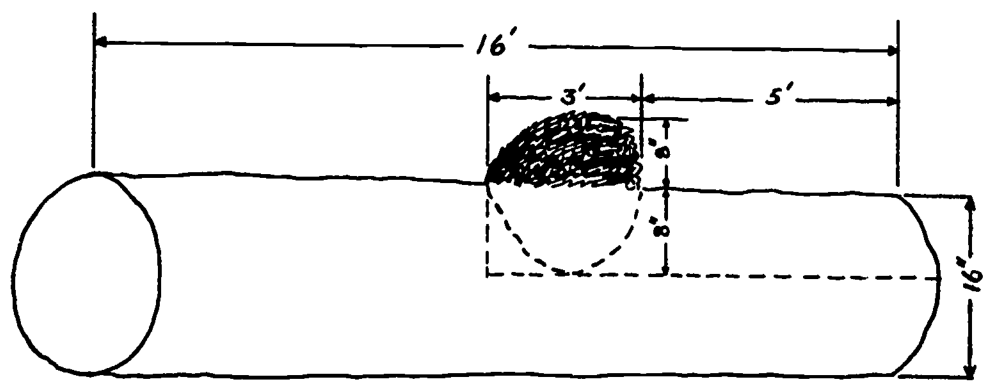


Figure 98.—Log with a burl.

Figure 98 shows a 16-foot log, 16 inches in diameter, with a burl located 5 feet from the scaling end of the log. The burl protrudes about 8 inches above the right cylinder of the log and is approximately 16 inches wide and 3 feet long. It has been found that a burl usually penetrates a log to approximately the same depth as the burl protrudes above the surface of the log. This burl would then penetrate the log approximately 8 inches. The estimated over-all size of this burl is 3 feet long, 16 inches wide, and 16 inches high; however, the scaler deducts only the amount of waste that falls within the scaling cylinder. The burl affects one-half of an 8-foot section or one-fourth of the 16-foot log. Deductions may be made by either the length cut or the segment scale. If the length cut method is used, the net scale of the log would be the same as a 12-foot log, 16 inches in diameter, or 120 board feet. The gross scale of a 16-foot log, 16 inches in diameter, is 160 board feet. The deduction for the above-noted burl is 40 board feet, or one-fourth of 160, or 120 board feet net scale.

9. CROOK OR SWEEP—Crooked logs are a common problem that confronts the scaler. The scaler should again remember that he considers in his gross scale only that amount of material that falls within the scaling cylinder.

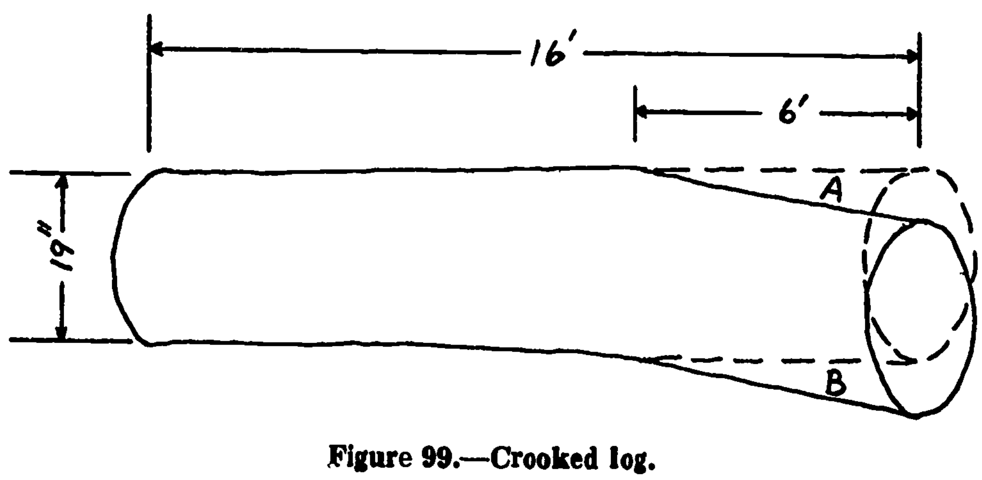


Figure 99.—Crooked log.

In scaling the log shown in Figure 99, the scaler will deduct the loss from that portion of the log designated by "A." The portion of the log designated "B" falls outside the scaling cylinder and should not be considered. The scaler should bear in mind that some 10-, 12-, and 14-foot lumber will be obtained from the portion of the log indicated by "A"; hence, it is estimated that a 2-foot length cut is sufficient deduction for this loss.

The gross scale of a 16-foot log, 19 inches in diameter, is 240 board feet. If the log has a 2-foot length deduction, the net scale would be that of a 14-foot log, 19 inches in diameter, or 210 board feet. This is the net scale of the log shown in Figure 99.

Skilled sawyers will obtain a maximum amount of lumber from a crooked log by loading the logs on the carriage with the belly extended either up or down.

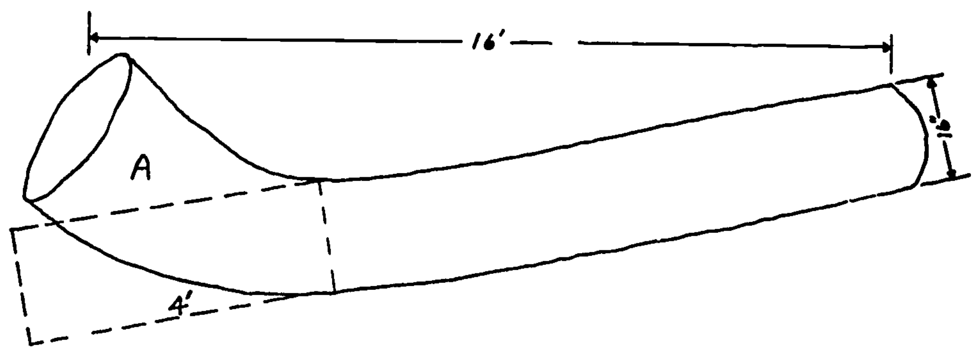


Figure 100.—Log with short crook, or "pistol grip," with heavy butt swell.

Figure 100 shows a crooked log, 16 feet long and 16 inches in diameter, with a gross scale of 160 board feet. It will be noted that three-fourths of the log is not affected by the crook. It will also be noted that the misplaced material designated by "A" is equal to approximately three-fourths of a 4-foot section; therefore, a length cut deduction of 3 feet should be made, leaving the equivalent of a 13-foot log scaling 130 board feet.

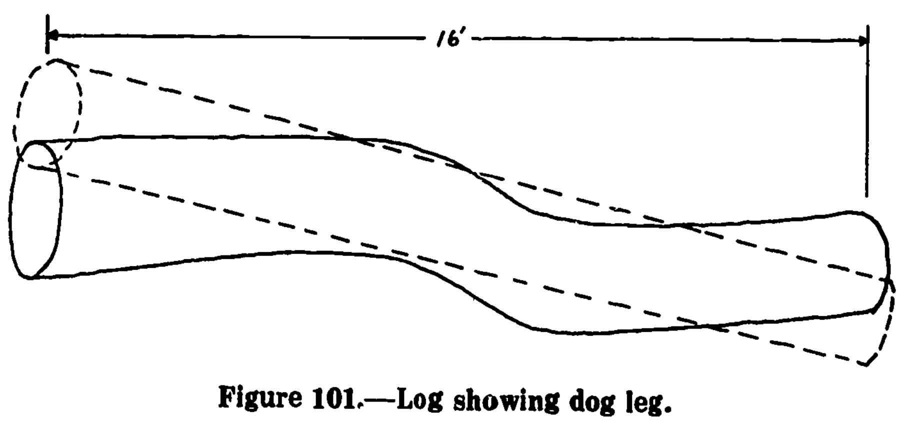


Figure 101.—Log showing dog leg.

Figure 101 shows a 16-foot log with a dog leg located directly in the center of the log. If this log were one of the pine species where the 33⅓ per cent merchantability standard applies, the log would be given some scale. If it were one of the mixed species where the 50 per cent merchantability standard applies, the log would be culled.

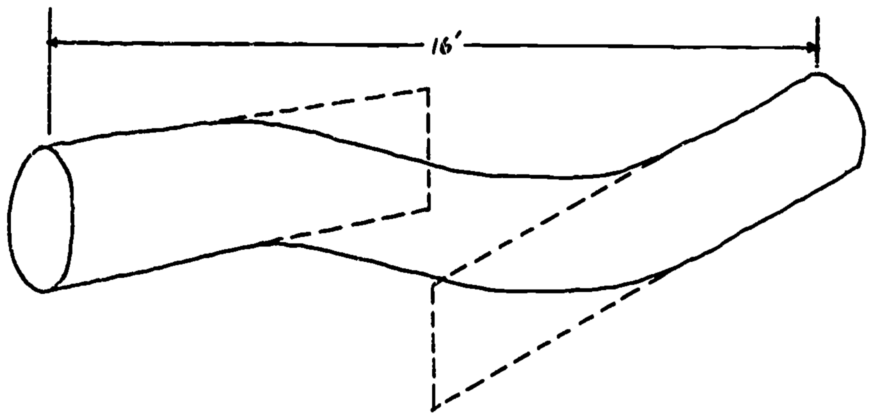


Figure 102.—Log with reverse crook.

Figure 102 is a cull log because of the short lumber lengths that it would produce.

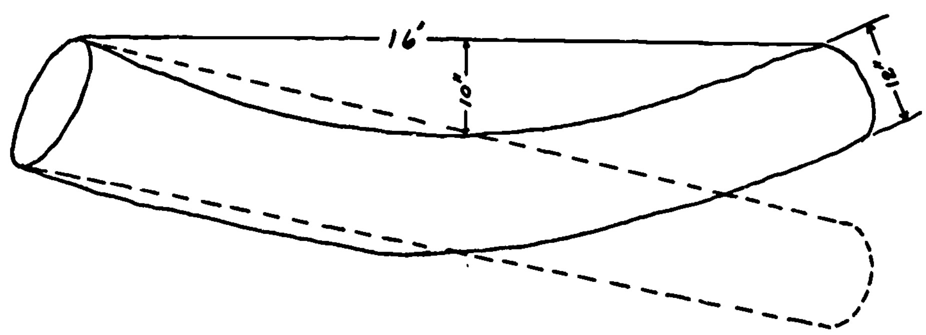


Figure 103.—Sketch illustrating sweep. If the sweep is over 10 inches, shorter log lengths—down to 10 feet—should be cut.

The log in Figure 103 shows severe sweep for the full length of a log. It is estimated that one-half of the gross scale would be recovered in sawing. The gross scale for the log is 80 board feet or a net scale of 40 board feet.

NOTE: Figures 99 through 103 are examples of poor log sawing and bucking in the woods. By cutting either longer or shorter lengths, the bucker could eliminate much of the sweep and some of the short crooks, which the scaler must contend with and which are safety hazards and time-consumers in the sawmill.

10. WORM HOLES—Worm holes are usually grouped into two general classes: (1) worm holes which are not of size or numerous enough to cause

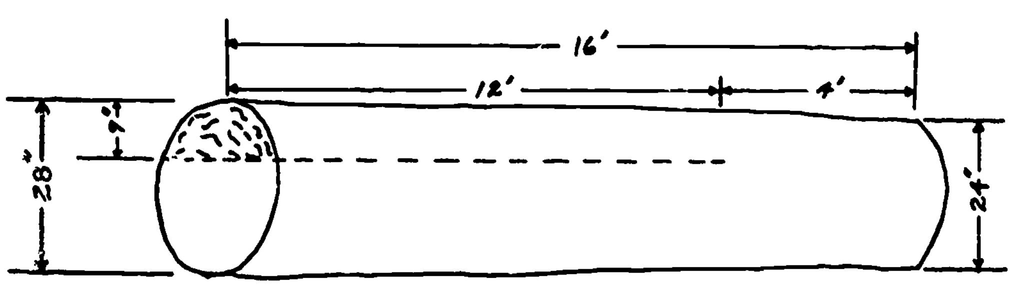


Figure 104.—Log with worm holes.

an actual loss of sound material; and (2) worm holes which are of such size and number that the affected lumber is unusable.

Figure 104 shows a 16-foot log, 24 inches in diameter, which has a gross scale of 400 board feet. Numerous worm holes occupy 9 inches of the cross section of the log from the butt end to within 4 feet of the top end. It will be noted that the diameter of the scaling cylinder is 24 inches. The worm holes are confined to an area within the scaling cylinder, measuring 6 inches by an average of 15 inches. Deductions may be made by either the standard rule or segment rule. By applying the standard rule, the scaler adds 1 inch to each dimension and calculates the deduction as follows:

$$\frac{7 \times 16 \times 16}{15} = 119 \text{ to the nearest } 10 = 120 \text{ board feet deduction}$$

The net scale for this particular log is 400 board feet gross scale, minus 120-foot deduction, or 280 board feet.

11. CROTCHES — The scaler must make proper deduction in scaling crotched logs. This is usually done by reducing the log length or by the method immediately following:

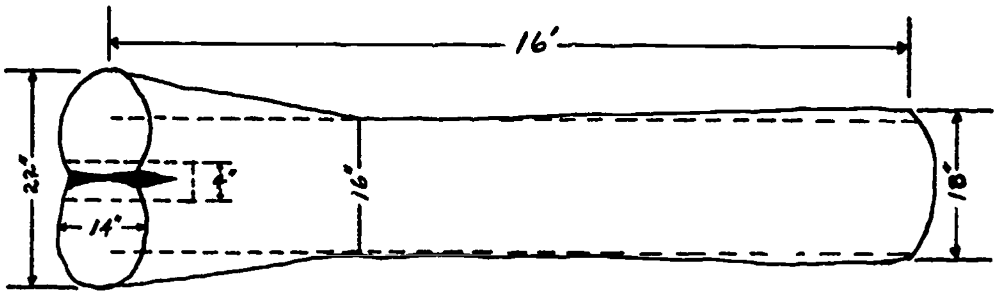


Figure 105.—A crotched log.

Figure 105 shows a 16-foot log with a butt diameter of 18 inches and with a crotch at the top end. The dimensions of the top end are 14 inches and 22 inches, respectively. It is obvious that an average of these two measurements would not give a true scaling diameter and the proper place to obtain the diameter for scaling this log is just below the swelling. Because this diameter cannot be obtained accurately without the use of calipers or a tape, it is customary for the scaler to measure the butt diameter, make allowance for taper, and thus arrive at the top diameter to be used. In Figure 105, this diameter is estimated to be 16 inches; therefore, the scale of this log would be that of a 16-foot log, 16 inches in diameter, or 160 board feet. From this 160 board feet the scaler must make proper deduction for any loss of material caused by bark inclusion, etc., in the crotch. Procedure for this type of deduction is outlined on page 86.

12. CAT FACE, FIRE SCAR, AND LIGHTNING SCARS—Cat faces, fire scars, and lightning scars are common problems facing the scaler. The most widely used method for determining deduction for these defects is the segment method applied as follows: Divide the log into sections, throw all the defect into one section, determine what fraction of the total length of the log within the scaling cylinder is affected, find the contents of this section on the scalestick, and determine how much will be wasted in sawing. This amount is then deducted from the gross scale of the log.

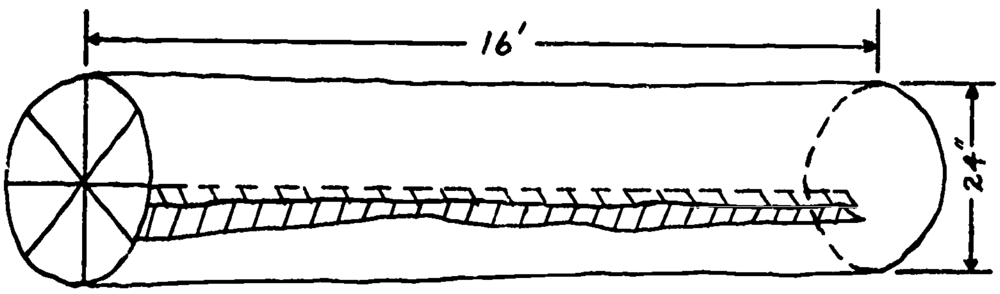


Figure 106.—Log showing lightning scar.

Figure 106 shows a 16-foot log, 24 inches in diameter at the top end, scaling 400 board feet, with a lightning streak winding around a portion of the surface and cross section of the log and extending along the entire length of the log.

By dividing the cross section of the log into eight segments, it is possible to throw all the waste into one segment which comprises one-eighth of the log: $400 \div 8 = 50$ board feet, the amount to deduct for the defect.

The experienced scaler, instead of going through the latter part of the above calculation, would probably deduct one-eighth from the length of the log and give it the scale of a 14-foot log.

In determining deduction in a 16-foot log by dividing the cross section of the log into segments, it is well to remember that cutting out a segment containing one-eighth of the cross section is equal to cutting off 2 feet of the log; and a segment containing one-fourth of the cross section is equal to cutting off 4 feet of the log. In the event that the lightning scar spirals around the log, the method of deduction is explained on page 46 under the heading "Spiral Check, Lightning Scar, or Pitch Seam."

MECHANICAL DEFECTS

Regardless of how efficient, the logging process will result in some damage to the logs when they are felled, bucked, transported, and handled by various mechanical devices. In many instances, this damage will result in a considerable loss of sound material; hence, the scaler must be able to recognize and make the proper deductions for the various types of mechanical defects.

1. UNDERCUT DAMAGE—Figure 107 illustrates a 16-foot log, 19 inches in diameter, with a gross scale of 240 board feet. Because of heavy undercut, one-third of a 2-foot section is lost. In determining the actual net scale for this particular log, proceed as follows: A 2-foot length cut deduction is first

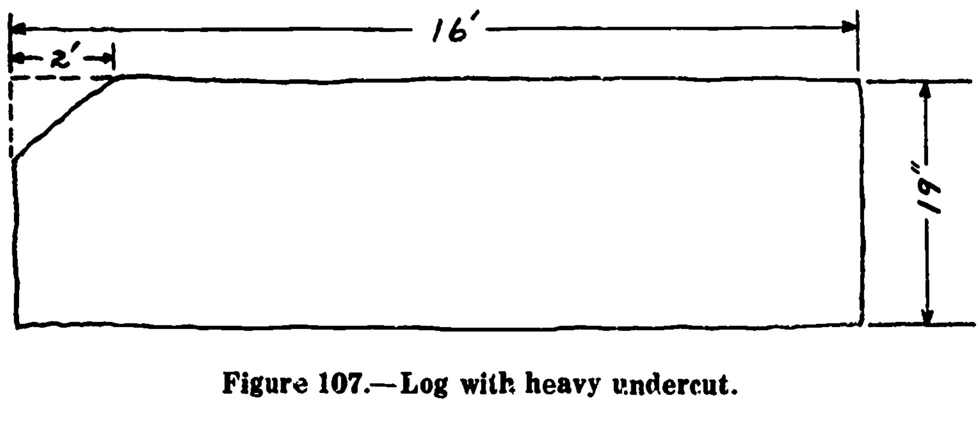


Figure 107.—Log with heavy undercut.

applied. A 14-foot log, 19 inches in diameter, scales 210 board feet, which is a difference of 30 board feet from the scale of a 16-foot log. However, only one-third of the 2-foot section was lost; so the 30 board foot difference is divided by three, which leaves a net deduction of 10 board feet. The net scale for this particular log would be 240 minus 10, or 230 board feet.

2. STUMP OR SLIVER PULL—Stump or sliver pull is a mechanical defect associated with felling and is caused by a portion of the wood in the butt log being left on the stump. Stump or sliver pull is an actual loss in volume and must be deducted from the gross scale. The deduction is usually made by the squared defect method.

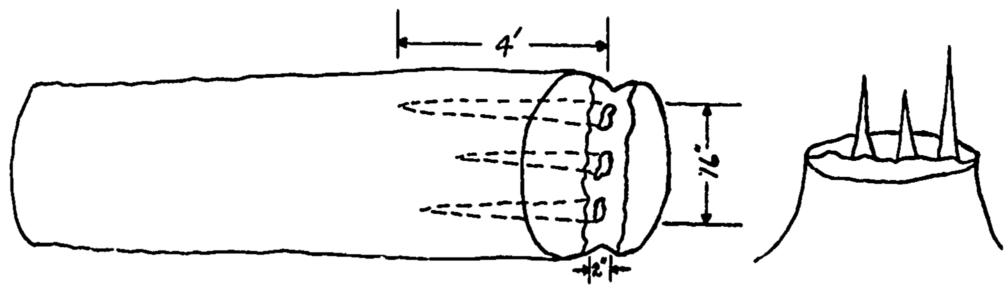


Figure 108.—Stump or sliver pull.

Figure 108 shows a stump pull measuring 2 inches by 16 inches and extending 4 feet into the butt of the log. The deduction would be made by adding 1 inch to each defect measurement and applying the squared defect method as follows:

$$3 \times 17 = 51 \text{ to next higher } 10 = 60$$

$$60 \times \frac{4}{16} = 15 \text{ or } 20 \text{ board feet deduction}$$

3. SLABBED OR BARBERCHAIRED LOGS—Slabbed or barberchaired logs is a mechanical defect that usually results from felling or handling.

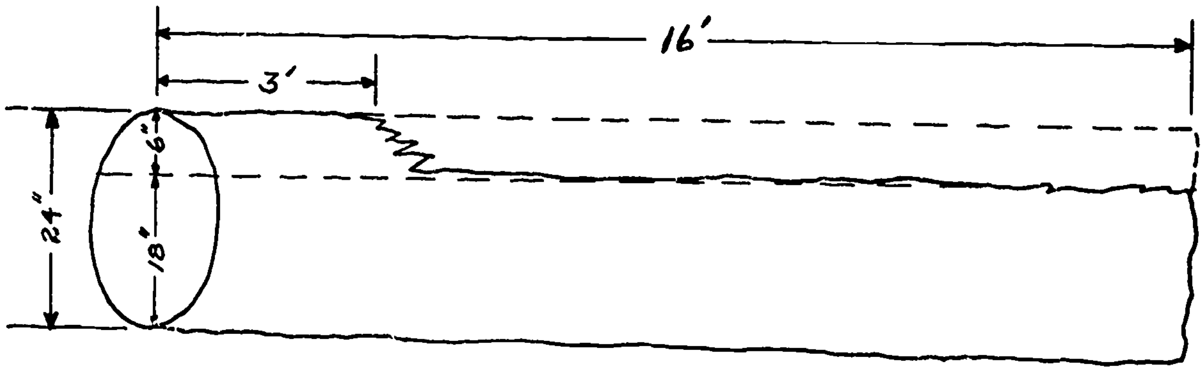


Figure 109.—Slabbed log.

It is estimated that one-fourth of the log is lost in Figure 109. A 16-foot log, 24 inches in diameter, scales 400 board feet. By applying the segment scale, one-fourth of 400 is 100, leaving a net scale of 300 board feet.

4. FORKED LOG (One Prong Broken Off)—In scaling the 16-foot log illustrated in Figure 110, the scaler will remember that in white pine and ponderosa pine, 6-foot lumber is merchantable. In other species, 8-foot lum-

ber is the merchantable minimum. If the log is white pine or ponderosa pine, the butt section only will be considered. This butt section will be allowed a 6-foot scale. The scaling diameter will be estimated by measuring the butt end and allowing for taper. If the log is a species other than white pine or ponderosa pine, it will be culled, inasmuch as it will not yield 8-foot lumber.

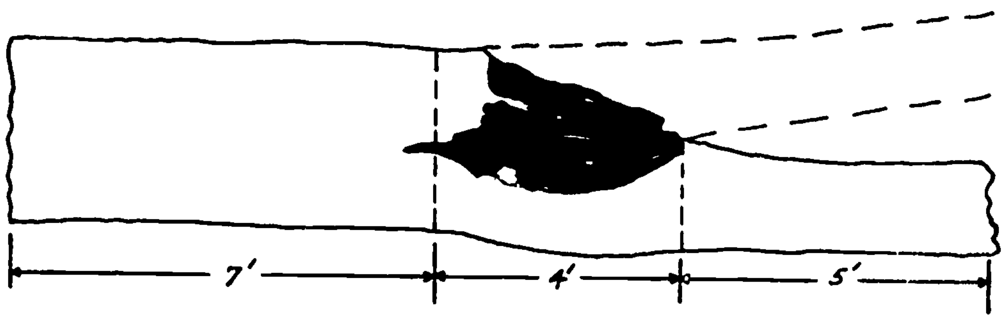


Figure 110.—Forked log with one prong broken off.

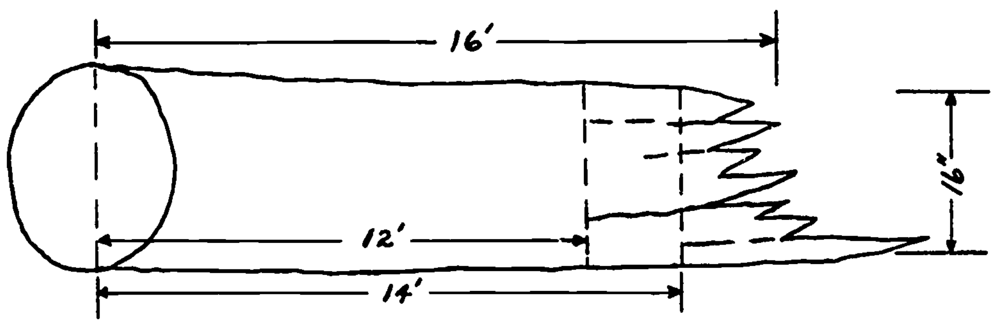


Figure 111.—Log with one broken end.

5. BROKEN END LOG (Shatter Breaks)—Figure 111 is an example of an approximate 16-foot log with one end broken. From a safety standpoint, this log should have been bucked off at the 14-foot mark, while it was still in the woods. Even if the log had been cut to the 14-foot length, it would still be necessary for the scaler to make an additional 2-foot deduction to compensate for shatter breaks and cracks in the end, plus probable other splits hidden under the bark. This log would then have the net scale of a 12-foot log, 16 inches in diameter, or 120 board feet.

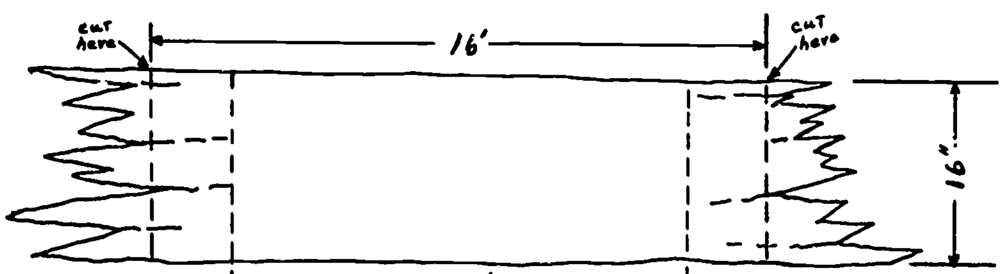


Figure 112.—Log showing two broken ends.

The 16-foot log in Figure 112 is an example of a log with two broken ends. In this case there would be a 4-foot length cut; that is, 2 feet on each end of the log. The net scale would then be that of a 12-foot log, 16 inches in diameter, or 120 board feet.

VI SCALING FROM THE STUMP

The following information was taken from the U.S. Forest Service NATIONAL FOREST SCALING HANDBOOK. Verbatim passages are indented.

> A stump scale is obviously less accurate than a scale of logs, even when measurements are made most carefully. Stump scales should never be used, therefore, when log scales are practicable. This method will be employed only in timber trespasses[2] and other cases where the logs have been removed and a log scale is impossible.
>
> The total log lengths cut from each tree should be measured in making a stump scale of a timber trespass. Often the indentation in the ground where the butt struck in felling can be located. From that point, which may be several feet from the stump, the total log length should be measured to the top, the direction of which can usually be determined by the undercut on the stump. The total length should be divided into logs . . .

and the volume should be determined from local volume tables.

> . . . or estimated from the total length of the log and the top and stump diameters.

(See method b., page 15.)

> The scale of each log may then be obtained from a scalestick . . .

or from the Scribner decimal C log rule.

> . . . Merchantable timber left in tops, in high stumps, and in unused logs should be scaled and entered separately. After each tree has been scaled, the top of the stump and the butt of the top should be . . . numbered for future identification. Deductions from the scale should be made for cull in accordance with the best data available for the class of timber concerned.
>
> Where the tops cannot be identified or have been moved or destroyed by fire, the scale may be obtained from the best volume table available for the locality and species by reducing the diameter at the top of the stump to diameter breast high. Volume tables may be used in lieu of stump scales, particularly when heights can be checked on trees bordering the cutting, if the results of this method are believed to be more accurate.

Extreme care should be used in scaling trespass timber, especially by a stump scale, and the scaler

> . . . should keep complete notes of the method used. If the case is brought into court, the scale and details of the methods used must be introduced as legal evidence.

[2]Timber trespass is the intentional or unintentional removal of timber from lands alien to the sales area.

VII MEASUREMENT OF POSTS, MINING TIMBER, POLES, PULP AND LOG DECKS

Although primary emphasis in this manual has been placed on the measurement of sawlogs, increased utilization of timber products is bringing about a need for standardization in measurement of forest products other than sawlogs. To this end, the following is offered.

POSTS

Posts are usually cut from western redcedar or juniper; however, red fir and larch are also used to some extent. Posts may be made from either live or dead peeled timber, provided it is reasonably sound. They are cut to specified lengths, generally from 5 to 8 feet, and may be round, triangular, or "split" with four or more sides.

Knots, char, discoloration, and other defects that do not affect the strength of the post are permitted. Rot is not permitted.

Table 6 shows the minimum top circumferences that are acceptable for posts of designated top diameters.

TABLE 6

MINIMUM TOP (SMALL END) MEASUREMENTS FOR POSTS

	Minimum Circumference (Small End)	
Designated Size	Seasoned Posts	Fresh Cut or Water-Soaked
4-inch	11¾ inches	12¼ inches
5-inch	14½ inches	15 inches
6-inch	17¼ inches	17¾ inches
7-inch	20¼ inches	20¾ inches
8-inch	23¼ inches	23¾ inches

The size of round posts at the small end may be ¼ inch less than the diameter specified.

HOP POLES

Hop poles are usually made from split or round western redcedar, lodgepole pine, or red fir; juniper is used occasionally.

Manufacturing specifications for hop poles are the same as those given for posts in the preceding section, except that hop poles are cut in multiples of 2 feet and range from 10 to 22 feet in length. Diameters range from 3 to 7 inches.

MINE STULLS

Mine stulls are usually made from sound, live, green larch or red fir timber which has been peeled. Top diameters for mine stulls range from 6 to 10 inches; lengths are usually 9 or 11 feet.

POLES

The following manufacturing and grading specifications for cedar, larch, Douglas fir, and lodgepole pine poles are from the R. G. Haley Corporation of Lewiston, Idaho, and are in accordance with standards established by the American Standards Association.

KNOTS

All knots must be sound and must be trimmed smooth and flush with the surface of the pole. Not acceptable are poles containing rotten knots, rough or bulgy knots, knots larger than 2½ inches in diameter, or a group of knots in any 1-foot section of the pole, the sum of whose diameters exceed 8 inches.

CAT FACES

Only sound cat faces less than 2 inches deep, which are located within 3 feet of the butt end, are permitted.

ROT

1. The tops of all poles must be sound and entirely free from rot or other defects.
2. The butts of all poles must be sound. Exception: Heart rot located in the center of the butt that does not exceed 5 per cent of the diameter of the butt may be accepted in limited quantity in poles that do not exceed 45 feet in length.
3. The entire pole must be free from ring rot, shell rot, sap rot, and all evidence of wood-rotting fungi, except as noted in 2. above.

CROOK AND SWEEP

1. Poles having short crook, kink, or two-way sweep are not acceptable.
2. One-way sweep is permitted, provided a tape which is tightly stretched from the center of the top to the center of the butt and passes across the arc made by the sweep, does not pass outside the body of the pole at any point.

OTHER DEFECTS

All poles shall be free from splits, shakes, cracks, breaks, bird holes, plugged holes, bulges, burls, splintered or worn sapwood, injurious checks, and the evidence of having been attacked by ants, bugs, or powder worms. Excessive swell, flare, or churned butts are not acceptable. Deep axe cuts or objectionable holes, cuts, gouges and bruises, or mutilation of the sapwood with peavies, cant hooks, tongs, chains, etc., are not permitted.

TRIM ALLOWANCE

All poles must be cut with at least 6 inches trim allowance and with tops and butts sawed square.

LIMBS

All limbs must be removed without tearing or gouging the adjoining sapwood of the pole.

Markings

Pole length should be clearly marked on the end of each pole.

Circumference Measurements

Circumference measurements at the top of the pole and 6 feet from the butt shall be not more than 7 inches larger than the specified minimum.

TABLE 7

MANUFACTURING AND GRADING SPECIFICATIONS FOR WESTERN REDCEDAR POLES

Official(Condensed)

Green or Water-Soaked Poles, Peeled

Class	1	2	3	4	5	6	7
Minimum Circumference At Top (Inches)	29.5	27.5	25	23	21	19	17
Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (Inches)						
20	36	33.5	31.5	29.5	27	25	23.5
25	39.5	37	34.5	32	30	27.5	26
30	42.5	40	37	34.5	32	30	28
35	45	42.5	39.5	37	34	32	29.5
40	48	45.5	42	39	36	33.5	
45	50.5	47.5	44.5	41.5	38.5		
50	52.5	49.5	46.5	43			
55	54.5	51.5	48	44.5			
60	56.5	53	49.5	46			
65	58	54.5	51	47.5			
70	59.5	56	52.5				
75	61.5	57.5	54				
80	63	59	55.5				
85	64.5	60.5	56.5				
90	65.5	62	58				

Seasoned Poles, Peeled

Seasoned poles up to 40 feet in length may be 1 inch smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

Seasoned poles 45 feet and longer may be 1½ inches smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

Note: All poles (green or seasoned) 55 feet and longer must have a minimum 8-inch top diameter (26-inch circumference green or 25-inch circumference seasoned).

TABLE 8

MANUFACTURING AND GRADING SPECIFICATIONS FOR LODGEPOLE PINE POLES

Green or Water-Soaked Poles, Peeled

Class	1	2	3	4	5	6	7
Minimum Circumference At Top (Inches)	29.5	27.5	25	23	21	19	17
Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (Inches)						
20	35	33	31	29	27	25	23.5
25	38.5	36	33.5	31.5	29.5	27.5	25.5
30	41.5	39	36.5	34	31.5	29.5	27.5
35	44	41	38.5	36	33.5	31	29
40	47	44	40.5	38	35.5		
45	49	46	43	40			
50	51	48	45	42			
55	52.5	49.5	46.5	43.5			
60	54.5	51	48	45			
65	56	52.5	49				

Seasoned Poles, Peeled

Seasoned poles up to 40 feet in length may be 1 inch smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

Seasoned poles 45 feet and longer may be 1½ inches smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

NOTE: All poles (green or seasoned) 55 feet and longer must have a minimum 8-inch top diameter (26-inch circumference green or 25-inch circumference seasoned).

TABLE 9

MANUFACTURING AND GRADING SPECIFICATIONS FOR DOUGLAS-FIR POLES (All Types)

Green or Water-Soaked Poles, Peeled

Class	1	2	3	4	5	6	7
Minimum Circumference At Top (Inches)	29.5	27.5	25	23	21	19	17
Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (Inches)						
20	34	32	30	28	26	24.5	22.5
25	37	35	32.5	30.5	28.5	26.5	24.5
30	40	37.5	35	32.5	30.5	28.5	26.5
35	42.5	40	37.5	34.5	32.5	30	28
40	45	42.5	39.5	36.5	34		
45	47	44.5	41.5	39			
50	49	46	43	40.5			
55	50.5	47.5	44.5	42			
60	52.5	49	46	43			
65	54	50.5	47.5				
70	55.5	52	49				
75	57	53.5	50				
80	58	54.5	51.5				
85	59.5	56	52.5				
90	60.5	57	53.5				

Seasoned Poles, Peeled

Seasoned poles up to 40 feet in length may be 1 inch smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

Seasoned poles 45 feet and longer may be 1½ inches smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

NOTE: All poles (green or seasoned) 55 feet and longer must have a minimum 8-inch top diameter (26-inch circumference green or 25-inch circumference seasoned).

TABLE 10
MANUFACTURING AND GRADING SPECIFICATIONS FOR WESTERN LARCH POLES

Green or Water-Soaked Poles, Peeled

Class	1	2	3	4	5	6	7
Minimum Circumference At Top (Inches)	29.5	27.5	25	23	•21	19	17
Length of Pole (Feet)	Minimum Circumference at 6 Feet from Butt (Inches)						
20	32.5	31	29	27	25	23.5	21.5
25	35.5	33.5	31.5	29	27	25.5	23.5
30	38	36	33.5	31.5	29	27	25.5
35	40.5	38	35.5	33.5	31	29	27
40	43	40.5	37.5	35	32.5		
45	45	42.5	40	37			
50	47	44	41.5	38.5			
55	48.5	45.5	43	40			
60	50	47	44	41.5			
65	51.5	49	45.5				
70	53	50	47				
75	54.5	51	48				
80	55.5	52.5	49				
85	57	53.5	50				
90	58	54.5	51.5				

Seasoned Poles, Peeled

Seasoned poles up to 40 feet in length may be 1 inch smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

Seasoned poles 45 feet and longer may be 1½ inches smaller in circumference 6 feet up from the butt and 1 inch smaller at top circumference.

NOTE: All poles (green or seasoned) 55 feet and longer must have a minimum 8-inch top diameter (26-inch circumference green or 25-inch circumference seasoned.)

PULPWOOD

Pulpwood is timber that will be reduced to pulp for the manufacture of paper, paperboard, and plastics. Although both green and dry wood are used for pulp, the green is preferred, because the strength of the green wood results in a superior manufactured product. All species of wood native to Idaho forests are adaptable to this use; however, because of processing methods, some mills cannot use the more resinous species of wood.

Most Idaho pulpwood is cut into sawlog lengths; but, in areas where timber diameters are small, as in the lodgepole forests of northern Idaho, considerable quantities of 8-foot pulpwood are cut and shipped for manufacture.

Pulpwood is most commonly measured in cubic feet and then converted into cords. A standard cord of wood is 128 cubic feet or a pile 4 feet by 4 feet by 8 feet, which will usually produce one unit or 200 cubic feet of chips. It is understood that each 1,000 board feet of log scale will produce two and one-fourth units, or 450 cubic feet of chips.

Western pulp mills, integrated with sawmills, often purchase their logs on the same basis as sawlogs—board footage calculated by the decimal C rule. This method does not give the true pulp volume of the log for two reasons: First, the decimal C rule allows for ¼-inch saw-kerf, which is not lost in pulp manufacture; second, the decimal C rule does not allow for log taper. However, a log rule showing both decimal C scale and pulp volume scale has been devised. This rule gives true pulp volume, inasmuch as it allows for 1-inch taper in logs up to and including 20 feet in length and makes no allowance for saw-kerf.

Merchantability standards for pulp logs usually specify that the log must be 50 per cent sound, but this requirement may vary with the accessibility of pulp timber and other conditions.

Scaling logs for pulp content is considerably different from scaling logs for lumber content. In scaling for pulp, the concern is with the yield of wood chips rather than with the yield of lumber; therefore, only those defects which will reduce the potential volume of sound wood fiber are considered in determining the net content of a log. Pulp cannot be manufactured from decayed wood; nor can charred wood be utilized, because carbon leaves black specks on the finished product. All charred portions must be removed from the log or the log must be culled. Checks, splits, crooks, blue stain, etc., which affect the lumber yield but not the chip yield, are not considered as defects in determining pulpwood volume.

Fungous diseases in timber probably cause more loss in pulpwood volume than all other defects combined. The fungous diseases which most commonly affect pulpwood yield are:

1. *Echinodontium tinctorium*, more commonly known as Indian paint or brown stringy rot, is the most serious rot where pulpwood is concerned. More grand fir, subalpine fir, and hemlock logs are unmerchantable because of this disease than from any other cause. (See pages 60-61.)
2. *Fomes pini*, ordinarily called ring rot, affects all conifers native to Idaho. This rot is especially severe in old-growth timber and causes much loss of pulp content, especially in white pine, ponderosa pine, larch, and spruce. (See pages 49-55.)
3. *Poria weirii*, which is better known as yellow ring rot, is a serious rot found in western redcedar. This rot often renders logs totally unusable for lumber, but it generally leaves large portions of sound pulpable wood between the rings of rot. (See pages 66-67.)

Table 11 may be used as a guide in determining the maximum size of rotten core that a log may have and still meet the 50 per cent merchantabliity standard.

TABLE 11

MAXIMUM ALLOWABLE SIZE OF DEFECTIVE CORES IN MERCHANTABLE PULP LOGS

Diameter of Log	Maximum Allowable Diameter of Rotten Core	Diameter of Log	Maximum Allowable Diameter of Rotten Core
8 inches	4 inches	29 inches	20 inches
9 "	5 "	30 "	21 "
10 "	6 "	31 "	21 "
11 "	7 "	32 "	22 "
12 "	8 "	33 "	22 "
13 "	8 "	34 "	23 "
14 "	9 "	35 "	24 "
15 "	10 "	36 "	24 "
16 "	11 "	37 "	25 "
17 "	11 "	38 "	26 "
18 "	12 "	39 "	27 "
19 "	13 "	40 "	28 "
20 "	14 "	41 "	28 "
21 "	14 "	42 "	29 "
22 "	15 "	43 "	30 "
23 "	16 "	44 "	30 "
24 "	17 "	45 "	31 "
25 "	17 "	46 "	32 "
26 "	18 "	47 "	33 "
27 "	19 "	48 "	33 "
28 "	19 "		

Table 12 may be used to determine the gross cubic foot content of logs in scaling pulpwood. The figures allow for 1-inch taper and are rounded off to the nearest cubic foot. To arrive at the net scale, compute the cubic footage of defect and deduct from the gross scale.

TABLE 12
LOG RULE FOR COMPUTING PULP VOLUME

	Log Lengths in Feet						
	8	10	12	14	16	18	20
Log Diameters in Inches	Cubic Foot Volume						
6	2	2	3	3	4	4	5
7	2	3	4	4	5	6	6
8	3	4	5	6	6	7	8
9	4	5	6	7	8	9	10
10	5	6	7	8	10	11	12
11	6	7	9	10	12	13	14
12	7	8	10	12	14	15	17
13	8	10	12	14	16	18	20
14	9	11	14	16	18	21	23
15	10	13	16	18	21	24	26
16	12	15	18	21	24	27	30
17	13	17	20	23	27	30	33
18	15	19	22	26	30	34	37
19	17	21	25	29	33	37	42
20	18	23	28	32	37	41	46
21	20	25	30	35	40	45	50
22	22	28	33	39	44	50	55
23	24	30	36	42	48	55	60
24	26	33	39	46	52	59	66
25	28	35	43	50	57	64	71
26	31	38	46	54	61	69	77
27	33	41	50	58	66	74	83
28	35	44	53	62	71	80	89
29	38	47	57	66	76	85	95
30	41	51	61	71	81	91	102
31	43	54	65	76	87	97	108
32	46	58	69	81	92	104	115
33	49	61	73	86	98	110	122
34	52	65	78	91	104	117	130

	Log Lengths in Feet						
	8	10	12	14	16	18	20
Log Diameters in Inches	**Cubic Foot Volume**						
35	55	69	82	96	110	124	137
36	58	73	87	102	116	131	145
37	61	77	92	107	123	138	153
38	65	81	97	113	129	146	162
39	68	85	102	119	136	153	170
40	72	89	107	125	143	161	179
41	75	94	113	132	150	169	188
42	79	99	118	138	158	177	197
43	83	103	124	145	165	186	206
44	86	108	130	151	173	194	216
45	90	113	136	158	181	203	226
46	94	118	142	165	189	212	236
47	98	123	148	172	197	222	246
48	103	128	154	180	205	231	257

LOG DECK INVENTORY

To obtain the scale of a deck of logs, measure the length of the deck in feet, the height of the deck in feet, and measure or estimate the length in feet of the average log in the deck. Then multiply length by height by length of the average log by ⅔ to obtain the cubic foot contents of the deck. Multiply this result by 6.1 to get the board foot contents of the deck.

The formula is stated as follows:

(Height in feet) × (Length in feet) × (Length of the average log in feet) × ⅔ × 6.1.

The figure 6.1 is the average board foot contents of a cubic foot of saw-logs in Idaho. In any particular operation, it may be necessary to raise or lower the board foot-cubic foot ratio of logs, depending on whether the logs are larger or smaller than average.

To check the board foot-cubic foot ratio on an individual operation, logs scaled into a deck can be checked against the dimensions or measurements of the deck for a board foot-cubic foot ratio for that operation.

This method gives the total gross only; it does not give volume by species. Also, the results must be qualified by the per cent of defect.

VIII LOG GRADING

Log grading is the classification of logs into grades for which minimum requirements have been established according to the quality-volume of various lumber grades or veneer stock a given log will yield.

The importance of log grading has long been recognized by the forest industry in Idaho; although industry-wide standards have not been fully agreed upon, some form of log grading is included in almost every log transaction. Therefore, it is important that the scaler be familiar with the several basic log grades.

The following are some of the log grades in common use throughout Idaho:[3]

PONDEROSA PINE SAWLOGS

GRADE I.

Description:

Shall be smooth and surface clear without indications of knots near the surface; one pin knot is permitted any place on the log.

Remarks:

1. Usually found in the lower two logs of a tree; rarely in the third log.
2. Top d.i.b. (diameter inside bark) of the log is seldom under 20 inches.
3. Small burls and pitch indicators are permitted.
4. Typical lumber: Clear and select.

GRADE II.

Description:

Shall be smooth and surface clear on three faces, with knots permitted on the fourth face; or shall be smooth and surface clear on the lower three-fourths of the length, above which a few knots are permitted; or shall be smooth or surface clear to within 2 feet of the scaling end, above which any number of knots are permitted. In any case, one pin knot is permitted on the clear portion of the log.

Remarks:

1. Usually found in the lower two logs of a tree; rarely in the third log.
2. Typical lumber: D select and better.

GRADE III.

Description:

May display knots which may vary from small, black (dead) knots to large sound or unsound knots, if they are staggered and are spaced at least 3 feet apart longitudinally; or if they are in solid whorls spaced at least 6 feet apart longitudinally. The surface clear areas must aggregate at least 50 per cent of the total surface of the log; each clear area must be at least 4 feet in length and one-fourth the circumference of the log in width.

[3]This material was adapted from a booklet entitled PONDEROSA PINE LOG GRADING MANUAL, which was published by the Oregon State Office of the U.S. Bureau of Land Management, November, 1956.

Remarks:

1. Seldom found in the top two logs of a tree.
2. Typical lumber: Saws out factory select and No. 1 and 2 shop.

GRADE IV.

Description:

May display numerous small and medium-sized red (live) knots; black (dead) knots which in the grader's judgment will cut out sound beneath the surface (usually on black barked logs) are also permitted. The size of the knots shall be proportionate to the size of the log; for example:

A 12-inch log may have 2-inch live or 1-inch dead knots.

A 24-inch log may have 4-inch live or 2-inch dead knots.

An average longitudinal spacing of not less than 2 feet between knots shall be required for logs with maximum knot sizes.

Remarks:

1. Usually found in young trees.
2. Typical lumber: No. 1 and 2 common and No. 3 common.

GRADE V.

Description:

May display numerous live and/or dead knots, the maximum size of which shall be proportionate to the size of the log; for example:

A 12-inch log may have 4-inch live and 2-inch dead knots.

A 24-inch log may have 5-inch live and 3-inch dead knots.

A 36-inch log may have 6-inch live and 4-inch dead knots.

An average longitudinal spacing of not less than 2 feet between knots shall be required for logs with maximum knot size. Logs with larger knots may also be admitted to this grade if their surface clear areas aggregate at least one-third of the total surface of the log; each clear area must be at least 3 feet in length by one-fourth the circumference of the log in width.

Remarks:

1. Found in any portion of the tree.
2. Typical lumber: No. 3 common, No. 4 common, and lower shop grades.

GRADE VI.

Description:

May be rough, coarse or densely-knotted logs, unsuited to any of the previous grades.

Remarks:

1. Found in any log position, but usually in top logs.
2. Typical lumber: Poorest common, No. 4 and No. 5.

PEELER LOG GRADES

(used by Potlatch Forests, Inc., Lewiston, Idaho)

No. 1 Peeler.

1. Maximum diameter for all species is 60 inches.
2. Logs less than 30 inches in diameter must be 100 per cent surface clear. Logs over 30 inches in diameter must be 90 per cent surface clear. No knots over 4 inches are permitted. Defects such as shake, slight rot, pitch, or stain that does not extend into the clear section of the log, are allowed. Severe spiral grain, heart shake, or split are not allowed.
3. Ends must be sawed square with no stump pull.
4. Peelers must be sound and must be from green timber.

No. 2 Peeler.

1. Maximum diameter for all species is 60 inches.
2. Minimum diameter is 20 inches, small end, inside bark.
3. Must be 75 per cent surface clear. Knots up to 4 inches when confined to 25 per cent of unclear surface of log are permitted.
4. Ends must be sawed square with no stump pull.
5. Peelers must be sound and must be from green timber.

APPENDIX

The following table lists symbols for defects as used by the U.S. Forest Service.

TABLE 13

SYMBOLS FOR DEFECTS

Natural Defects (Existing in log at time the tree is felled)

Type of Defect	Symbol
All interior rot	R
Sap rot	S
Heart check	Ch
Pitch seam	PS
Shake	Sh
Pitch rings	PR
Spangles (more than two PS's or Ch's)	Sp
Lightning scar	LS
Weather check	WC
Rotten knot	RK
Bark seam	BS
Massed pitch	MP
Sweep	SW
Crook	CR
Cat face	CF
Fire scar	FS
Crotch	Y
Burl	BL
Knot cluster	KC
Large knots (rough cut)	RC
Grubworm holes (if massed)	WH

Mechanical Defects (Occurring after tree is felled)

Type of Defect	Symbol
Bucker's break	BB
Felling break	FB
Stump shot	SS
Logging (such as cat damage)	LD

INDEX